

FIELD MODIFICATION FORM
FOR
CORNELL DUBILIER ELECTRONICS SUPERFUND SITE: OU4 BOUND BROOK
THE LOUIS BERGER GROUP, INC.

DATE: June 27, 2012

DOCUMENT: Quality Assurance Project Plan
Cornell Dubilier Electronics Superfund Site: OU4 Bound Brook

ACTIVITY: Field Modification No. 6
Porewater Program

REQUESTED MODIFICATION:

On behalf of the United States Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (USACE), The Louis Berger Group, Inc. (Berger) and ARCADIS/Malcolm Pirnie, Inc. are conducting a Remedial Investigation / Feasibility Study (RI/FS) of Bound Brook in Middlesex County (New Jersey), which is designated as Operable Unit 4 (OU4) of the Cornell Dubilier Electronics Superfund Site. According to the "Final Quality Assurance Project Plan (QAPP)" (dated October 2010), real-time modifications to the project can be implemented by documenting the modification and obtaining approval from the Project Manager and Site Quality Control Officer or designee (refer to Worksheet #6). Field Modification No. 6 addresses data needs for completing a porewater program.

The conceptual site model for OU4 is that historical disposal of polychlorinated biphenyl (PCB)-containing capacitors, PCB transformer oils, and volatile organic compound (VOC) solvents at the former Cornell-Dubilier Electronics (CDE) facility is the source of contamination to the groundwater and Bound Brook sediments. Moreover, the ongoing discharge of impacted groundwater presents a continuing source of contamination to Bound Brook sediments and porewater. Preliminary risk calculations suggest that contaminated groundwater discharge into the brook may present a potential risk to ecological receptors and human health. In these preliminary risk calculations (memorandum to the USACE dated November 23, 2011), the contaminant concentration in the surface water was estimated by calculating a contaminant mass flux to Bound Brook based on available groundwater chemical data, groundwater gradient data, hydraulic conductivity data, and Bound brook base flow. The estimated aqueous concentrations were then screened against aquatic life ecological screening values, wildlife ecological screening values, and National Recommended Water Quality Criteria (NRWQC) for human health (based on consumption of organisms only). The screening level revealed a potential exceedance of the risk criteria.

Consequently, the project team is recommending a direct measurement of in-situ porewater PCB concentrations adjacent to the former CDE facility to determine if potential ecological and human health risks are associated with contaminated porewater in OU4 Bound Brook.

RATIONALE:

The QAPP is being modified to address the following data needs and questions:

- What is the concentration of PCB congeners in porewater adjacent to the bedrock and in the biologically active zone of Bound Brook?
- Will detected PCB porewater concentrations impact the overlying surface water concentrations to levels that could potentially exceed the surface water risk criteria?
- Are VOC compounds present in the porewater, and if so, does their concentrations suggest a discharge of contaminated groundwater to Bound Brook (additional lines of evidence)?
- What is the concentration of PCB congeners in co-located sediment and surface water samples?

- What are the sediment-porewater partitioning coefficients for PCB congeners?
- Are there distinct groundwater discharge points in Bound Brook and if so, where are they?

ATTACHMENTS:

Supplemental QAPP Worksheets (and associated attachments)

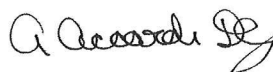
Leonard J. Warner

The Louis Berger Group, Inc. Project Manager: _____




AmyMarie Accardi-Dey

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Jim McCann

ARCADIS/Malcolm Pirnie, Inc. Site Quality Control Officer: _____



ACRONYM LIST

To simplify this QAPP modification, acronyms are defined in the list below (not embedded in the text).

ABS = Absolute difference between the two values
Berger = The Louis Berger Group, Inc.
CCB = Continuing Calibration Blank
CCV = Continuing Calibration Verification
CDE = Cornet Dubilier Electronics
cm = centimeters
COPC = Contaminant of Potential Concern
COPEC = Contaminant of Potential Ecological Concern
Conc. = Concentration
DQO = Data Quality Objective
DQI = Data Quality Indicators
EDL = Estimated Detection Limit
FS = Feasibility Study
GC/MS = Gas Chromatography / Mass Spectroscopy
GPC = Gel Permeation Chromatography
GPS = Global Positioning System
HCl = Hydrochloric Acid
hr = hour
HRGC = High Resolution Gas Chromatography
HRMS = High Resolution Mass Spectroscopy
ICB = Initial Calibration Blank
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Level of Quantitation
MB = Method Blank
MDL = Method Detection Limit
MEDD = Multimedia Electronic Data Deliverable
MIT = Massachusetts Institute of Technology
mL = milliliter

MS = Matrix Spike
MSD = Matrix Spike Duplicate
ng/g = nanograms per gram
NJDEP = New Jersey Department of Environmental Protection
NRWQC = National Recommended Water Quality Criteria
OU2 = Operable Unit 2
OU3 = Operable Unit 3
OU4 = Operable Unit 4
PCB = Polychlorinated Biphenyls
PE = Performance Evaluation
pg = picograms
pg/L = picograms per liter
QAPP = Quality Assurance Project Plan
QC = Quality Control
QL = Quantitation Limit
RI/FS = Remedial Investigation / Feasibility Study
RM = River Mile
RPD = Relative Percent Difference
RT = Retention Time
SOP = Standard Operating Procedure
SVOC = Semi-volatile Organic Compounds
TCL = Target Compound List
TOC = Total Organic Carbon
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency
VOC = Volatile Organic Compounds
WS = Worksheet
µg/L = micrograms per liter
µm = micrometer

CONTENT

SOP No. 28: Porewater Contaminant Evaluation Using Polyethylene Passive Samplers and VOC Sampling (includes field sheet)
SOP No. 29: Stream Flow/Water Quality Survey for Potential Groundwater Discharge (includes field sheet)
Attachment 1: Copies of existing 2011 field sheets for sediment probing, sediment coring, surface sediment sampling, and geological classification log
Attachment 2: Copies of passive sampler literature references
Attachment 3: Copies of laboratory analytical standard operating procedures
Figure 1: May 2012 Stream Flow Transects and Propose Porewater Sampling Locations

Title: Field Modification No. 6
 Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
 Date: February 2012

QAPP Worksheet 4
Project Personnel Sign-Off Sheet

Project Personnel Sign-Off Sheet

Project Personnel	Title	Telephone Number	Signature	Date Read
Ken Maas	USACE Project Manager	816-389-3709	<i>[Signature]</i>	8/23/12
To Be Determined <i>Amy Darpinian</i>	USACE Project Chemist	816-389-3897	<i>Amy Darpinian</i>	8/23/12
Mark Austin	USEPA Project Manager	212-637-3934	<i>Mark Austin</i>	9/6/12
Edward Dudek	The Louis Berger Group, Inc. Project Manager	914-798-3711	<i>[Signature]</i>	6/27/2012
Len Warner	The Louis Berger Group, Inc. Technical Project Manager	914-798-3721	<i>Len Warner</i>	6/27/2012
AmyMarie Accardi-Dey	The Louis Berger Group, Inc. Deputy Project Manager	914-798-3712	<i>A Accardi-Dey</i>	6/27/2012
Jim McCann	Arcadis/Malcolm Pirnie, Inc. Site Quality Control Officer	845-453-2380	<i>J McCann</i>	8/13/2012
F. Chris Purkiss	The Louis Berger Group, Inc. Field Leader	973-407-1685	<i>F Chris Purkiss</i>	7/24/12
Field Crew	To Be Determined			
<i>Andrew Woltson</i>	<i>Field Crew</i>		<i>[Signature]</i>	6/27/2012
<i>Aronil Earnhardt</i>	<i>Field Crew</i>	973-407-1146	<i>[Signature]</i>	6/27/2012
<i>Jonathan Gagliardi</i>	<i>Field Crew</i>		<i>[Signature]</i>	6/27/2012

QAPP Worksheet 10

Problem Definition

Problem Definition (Worksheet 10)

The problem to be addressed by the project:

On behalf of the USACE and USEPA, Berger and ARCADIS/Malcolm Pirnie, Inc. are conducting a RI/FS at the Cornell-Dubilier Electronics (CDE) Superfund Site in Middlesex County, New Jersey. The former CDE company released material contaminated with PCB and trichloroethene (TCE) directly onto the soils during its operations. USEPA has detected PCB compounds in the groundwater, soil, and in building interiors at the former CDE manufacturing facility and at nearby residential, commercial, and municipal properties.

The conceptual site model for Bound Brook is that historical disposal of PCB-containing capacitors, PCB transformer oils, and VOCs at the former CDE facility (OU2) is the source of contamination to the groundwater (OU3) and Bound Brook sediments (OU4). Preliminary modeling has also suggested that water supply well pumping has impacted the regional groundwater flow pattern and the orientation of the contaminated groundwater plume, which has migrated past the boundaries of the former CDE facility. Water supply well pumping is also impacting the hydraulics of Bound Brook – and plays a role in whether the brook is a “gaining” stream or “losing” stream. Under current conditions with water supply wells not pumping, Bound Brook is generally a “gaining” stream. Consequently, near the former CDE facility, contaminated groundwater is likely discharging to Bound Brook and influencing the composition of porewater in the sediment bed. The ongoing discharge of impacted groundwater presents a continuing source of contamination to Bound Brook sediments and porewater. This discharge along with (1) historical (direct) discharges from the former CDE facility process drains, (2) transport of contaminated surface soils from the former CDE facility via storm run-off, and (3) historical disposal of capacitors and process waste in the banks adjacent to the former CDE facility are the likely sources of contamination to Bound Brook. For more information, refer to the OU4 RI/FS Work Plan (dated July 2010) and the OU3 Draft Remedial Investigation Report (dated June 2011).

The environmental questions being asked:

The human health and ecological Conceptual Site Exposure Models are provided in the OU4 RI/FS Work Plan (July 2010). A screening of available sediment, floodplain soil, tissue (biota), and surface water sample data collected from OU4 revealed the presence of VOCs, SVOCs, PCB Aroclors, pesticides, and metals. Preliminary risk calculations also suggest that contaminated groundwater discharge into the brook may present a potential risk to ecological receptors and human health. In these preliminary risk calculations (memorandum to the USACE dated November 23, 2011), the contaminant concentration in the surface water was estimated by calculating a contaminant mass flux to Bound Brook based on available groundwater chemical data, groundwater gradient data, hydraulic conductivity data, and Bound brook base flow. The estimated aqueous concentrations were then screened against aquatic life ecological screening values, wildlife ecological screening values, and NRWQC for human health (based on consumption of organisms only). The screening level revealed a potential exceedance of the risk criteria.

Consequently, the project team is recommending a direct measurement of in-situ porewater PCB concentrations adjacent to the former CDE facility to determine if potential ecological and human health risks are associated with contaminated porewater in OU4 Bound Brook. VOC concentrations in porewater will also be characterized as an additional line of evidence for groundwater discharge to Bound Brook. Once the OU4 risk assessment is completed, the need to address groundwater discharge to Bound Brook will be determined. Porewater measurements, along with the RI field investigation data, will be used to evaluate nature and extent of contamination; evaluate potential remedial alternatives; identify migration pathways; identify potential receptors; and evaluate potential human and ecological health risks in OU4.

Specific questions to be answered are:

- What is the concentration of PCB congeners in porewater adjacent to the bedrock and in the biologically active zone of Bound Brook?
- Will detected PCB porewater concentrations impact the overlying surface water concentrations to levels that could potentially exceed the surface water risk criteria?
- Are VOC compounds present in the porewater, and if so, do their concentrations suggest a discharge of contaminated groundwater to Bound Brook (additional lines of evidence)?

Problem Definition (Worksheet 10)

- What is the concentration of PCB congeners in co-located sediment and surface water samples?
- What are the sediment-porewater partitioning coefficients for PCB congeners?
- Are there distinct groundwater discharge points in Bound Brook and if so, where are they?

Observations from any site reconnaissance reports:

Site reconnaissance and other field work in the OU4 study area occurred between November 2010 and March 2011 (Phase 1) and between April 2011 and December 2011 (Phase 2). The first part of a two part stream flow/water quality survey was conducted on May 7-8, 2012 to characterize and screen areas of potential groundwater discharge to Bound Brook. The second part was conducted on June 20-22, 2012. (Refer to SOP No. 29 for further information on the stream flow/water quality survey conducted to identify passive sampler locations.)

A synopsis of secondary data or information from site reports:

- RI/FS Work Plan – Cornell Dubilier Electronics Superfund Site, OU4 Bound Brook. Prepared by Berger for the USACE and USEPA (July 2010).
- RI/FS QAPP – Cornell Dubilier Electronics Superfund Site, OU4 Bound Brook. Prepared by Berger for the USACE and USEPA (October 2010) and associated modifications:
 - Field Modification No. 1 (dated April 2011) – Combined Phase 2 and Phase 3 of field program
 - Field Modification No. 2 (dated September 2011) – Modifications to the surface water program
 - Field Modification No. 3 (dated October 2011) – Modifications to soil boring program
 - Field Modification No. 4 (dated October 2011) – Expansion of study area and additional sediment traps and Ekman dredge samples
 - Field Modification No. 5 (anticipated June 2012) – Modifications to the reference area program (under development)
 - Field Modification No. 6 (dated May 2012; discussed herein) – Development of a porewater program
 - Field Modification No. 7 (dated November 2011) – Development of modeling data needs
- Summary Report “Bound Brook 2010 Land Survey and Sediment Probing Field Activities,” Prepared by Berger for the USACE and USEPA (February 2011).
- Data collected during the 2010-2011 OU4 Bound Brook field program, including but not limited to:
 - Stream Flow Survey
 - High Resolution Sediment Cores
 - Low Resolution Sediment Cores
 - Geotechnical Sediment Cores
 - Surface Sediment (Ekman Dredge) and Sediment Traps
- OU3 2009-2011 groundwater remedial investigation data.

The possible classes of contaminants and the affected matrices:

Porewater samples (polyethylene passive samplers) will be analyzed for the following parameters:

- PCB congeners (USEPA Method 1668C)

Porewater samples (passive sampling devices to create time-integrated aqueous samples) will be analyzed for the following parameters:

- VOC (SW-846 Method 8260B)

Surface water samples (polyethylene passive samplers) will be analyzed for the following parameters:

- PCB congeners (USEPA Method 1668C)

Problem Definition (Worksheet 10)

Surface sediment samples (0-5 cm) located adjacent to the polyethylene passive sampler will be analyzed for the following parameters using the methods and performance criteria outlined in QAPP Modification No. 1 (dated April 2011):

- PCB congeners (USEPA Method 1668C)
- TOC (Modified SW-846 Method 9060)

Geotechnical sediment cores collected adjacent to the polyethylene passive sampler will be analyzed for the following parameters using the methods and performance criteria outlined in QAPP (dated October 2010):

- Grain size (ASTM D422)
- Atterburg Limits (ASTM D4318)
- Density (ASTM D2937)
- Moisture (ASTM D2216)

The rationale for inclusion of chemical and nonchemical analyses:

Porewater is being analyzed for PCB congeners and VOC compounds because they are the COPC/COPEC in the contaminated groundwater plume, which has migrated from the former CDE facility (OU2). Preliminary risk calculations based on estimated groundwater discharge to Bound Brook showed that PCB concentrations could exceed the wildlife ecological screening values and NRWQC for human health (based on consumption of organisms only). The presence of VOC in the porewater near the bedrock underlying the sediment bed will represent a line of evidence that groundwater is discharging to Bound Brook. (Geotechnical data from the sediment bed are required to convert contaminant mass in the passive sampler to porewater concentration.)

Surface water is being analyzed for PCB congeners to estimate a contaminant flux from the porewater to the overlying surface water. These data will also provide a direct PCB surface water concentration to support the risk assessments.

Surface sediment (measured at 0-5 cm below the sediment-water interface) is being analyzed for PCB congeners to estimate a site-specific partitioning coefficient in the biologically active zone (assuming that the sediment and porewater are at equilibrium). These data will support the risk assessments in understanding what sediment-bound contaminant burden is bioavailable. (TOC is required to calculate the partitioning coefficient.)

PCB congeners will be reported for this project (opposed to PCB Aroclors) because passive sampler technology uses congener-specific, equilibrium equations to convert contaminant mass in the sampler to porewater concentration. PCB Aroclor concentrations can be calculated from congener data, as necessary, using established conversion equations.

Project decision conditions (“If..., then...” statements):

RI field data will be collected to fulfill the DQOs (refer to QAPP Attachment 1, October 2010), which are designed to evaluate nature and extent of contamination; evaluate potential remedial alternatives; identify migration pathways; identify potential receptors; and evaluate potential human and ecological health risks in OU4. If PCB compounds are detected in the porewater at unacceptable risk levels, then a “porewater pathway” will be evaluated in the OU4 risk assessment and the response actions for groundwater will be revisited.

QAPP Worksheet 11

Project Quality Objectives/Systematic Planning Process Statements

Project Quality Objectives /Systematic Planning Process Statements (Worksheet 11)

Who will use the data?

USEPA, USACE, NJDEP, project investigation team, and risk assessors

What will the data be used for?

Data will be used to evaluate nature and extent of contamination; evaluate potential remedial alternatives; identify migration pathways; identify potential receptors; and evaluate potential human and ecological health risks in OU4.

What type of data is needed?

Proposed PCB Field Plan for Porewater, Surface Water, and Surface Sediment

The proposed field plan for measuring in-situ PCB porewater and surface water concentrations is the deployment of passive samplers (composed of polyethylene) into the sediment beds and water column adjacent to the former CDE facility. Passive samplers will be constructed and prepared for deployment by Dr. Philip Gschwend of MIT using methods established by his laboratory (refer to Gschwend et. al., 2011 Environmental Toxicology and Chemistry, volume 30(6), pp 1288). In general, each passive sampler will consist of a polyethylene plastic sheet “sandwiched” between two aluminum plates. “Windows” in the plates will expose the polyethylene to the porewater and allow the partitioning of PCB compounds from the porewater into the polyethylene material. Refer to SOP No. 28 on sampling design and implementation. Polyethylene used will consist of low-density polyethylene sheets: 5 cm wide × 50 cm long (exposed) × 25 µm thick.

In this proposed field plan, a total of 20 passive samplers will be deployed in Bound Brook adjacent to the former CDE facility with a focus on areas of potential groundwater discharge. Potential sampling locations were selected based on evaluation of the May 2012 water quality/stream flow survey and reconnaissance of sediment bed thickness conducted in June 2012. A summary of potential sampling locations is described below (refer to Worksheet 18 for details and Figure 1). Note that geotechnical data are required to convert contaminant mass in the sampler to a dissolved-phase porewater concentration. For sampling locations that are not adjacent to a 2011 sediment core, an additional geotechnical sediment core will be collected.

- Three upstream sampling locations were selected between Talmadge Bridge at RM8.3 and the upstream side of the twin culverts, where Bound Brook passes beneath a former railroad spur, at RM6.55. A passive sampler will be deployed at each sampling location, yielding 3 passive samplers in this upstream area.
- Ten sampling locations were selected within Reaches 1-4 of the OU3 groundwater flux model between the downstream side of the twin culverts at RM6.55 and the Lakeview Avenue Bridge at RM6.15. One or two passive samplers will be deployed at each sampling locations, yielding 15 passive samplers in the modeled area. Note that when two sets of passive sampler are deployed at a potential sampling location, they will represent distinct samples (not co-locates).
- Two downstream sampling locations were selected between Lakeview Avenue Bridge at RM6.15 and downstream of the OU3 groundwater flux model at RM5.8. A passive sampler will be deployed at each sampling location, yielding 2 passive samplers in the downstream area.

At each sampling location, the passive sampler will be inserted vertically into the sediment bed and pushed to designed maximum depth or until it encounters the underlying bedrock refusal. A portion of each passive sampler will remain in the water column to simultaneously collected porewater data and surface water data at each location. Following a 30-day deployment (to allow partial equilibrium of PCB compounds between the aqueous phase and the polyethylene material), the samplers will be retrieved and the polyethylene material in the sampler will be removed and divided into discrete depth intervals. It is currently proposed that at each of the sampling locations three discrete depths will be targeted for immediate analysis; the remaining depth intervals will be archived (according to Worksheet 19). The three proposed depths are (1) the section of polyethylene sheet above the sediment-water interface that is exposed to the surface water, (2) the section of polyethylene sheet that is below the sediment-water

interface (0-5 cm) that is exposed to the porewater in the biologically active zone, and (3) the bottom 5 cm of the polyethylene sheet (this exact depth will vary depending on the penetration depth of the sampler) that will be proximal to bedrock in some areas. If bedrock is encountered, this bottom sample will represent the porewater concentrations near the underlying bedrock where groundwater discharges to the sediment. If bedrock is not encountered, this bottom sample will represent the porewater concentration at refusal. (Note that when the sampler frame encounters bedrock, the polyethylene sheet in the sampler will be elevated 8 cm above the bedrock due to the construction of the frame.)

While retrieving the passive sampler, the surface sediment (0-5 cm below the sediment-water interface) that is located adjacent to the passive sampler will be collected, processed, shipped, and analyzed according to the procedures defined in QAPP Modification No. 1 (dated April 2011). Surface sediment will be used to calculate a site-specific partitioning coefficient.

Polyethylene material will be extracted at a subcontracted laboratory (Axys Analytical Services Ltd) following an established laboratory standard operating procedure using a solvent:solvent extraction technique. Extracts will then be analyzed following USEPA Method 1668C for PCB congeners (refer to Worksheet 23 for method modifications); sample delivery groups will contain all method-required batch quality control samples and results will be recovery-corrected (refer to Worksheet 12, 15, and 28). The final laboratory data package will report PCB contaminants in units of mass of each PCB congener per mass of polyethylene sampler (pg/g sampler). Berger will then collaborate with Dr. Gschwend of MIT to convert the reported (detected) contaminant mass into porewater and surface water concentrations using established partitioning equations and existing geotechnical data on the sediment bed. The final PCB concentration for surface water and porewater will represent a time-integrated, non-colloidal bound, dissolved-phase concentration that is expected to be bioavailable to benthic organisms and macroinvertebrates.

For sediment samples, PCB congeners, TOC, and geotechnical parameters will be collected, processed, and analyzed according to the methods and performance criteria defined in the QAPP and Modification No. 1. Data will be reported in units of concentration (dry-weight basis).

What type of data is needed?

Proposed VOC Field Plan for Porewater

The proposed field plan for measuring in-situ porewater VOC concentration is the installation of stiling tubes into the sediment bed near each PCB passive sampler. It is anticipated that the tube will be perforated along the bottom 15 cm to allow porewater in the sediment bed to percolate into the tube. (Tubes will be either fabricated by the Berger field team or purchased directly from a manufacturer.) Each tube will be pushed to refusal or until it encounters the underlying bedrock. The tube will be flushed with distilled water and then left in the sediment bed for the porewater to percolate into the tube. Inside each tube, Berger will deploy either a commercially available VOC passive diffusion bag or a modified VOC vial that will be filled with reagent-grade, analyte-free water and covered with a low-density polyethylene membrane and metal septum cap. (Field-fabricated VOC samplers may be necessary to accommodate field conditions and dimensions of the sampling tubes that can be feasibly installed in the relationship to the thin layer of unconsolidated sediment.) The VOC sampler will remain in the stilling tube for two 2-week deployments, allowing dissolved-phase VOC analytes to partition through the polyethylene membrane and accumulate inside the sampler. The resulting VOC sample will represent a time-integrated, dissolved-phase VOC sample. (Refer to SOP No. 28 for detail on sampling design and implementation.) The VOC samples will be analyzed following USEPA Method 8260B by a subcontracted laboratory (Lancaster Laboratories) to achieve low-level VOC detections (refer to Worksheet 23). The final laboratory data package will report VOC concentrations in units of $\mu\text{g/L}$; all method-required batch quality control samples will be documented (refer to Worksheet 12, 15, and 28). The detection of VOCs in the porewater (especially trichloroethene and its chemical breakdown byproducts) will act as another line of evidence that the contaminated groundwater plume migrating past the former CDE facility is discharging into Bound Brook.

How “good” do the data need to be in order to support the environmental decision?

Data must be technically defensible and of sufficient quality to support the project DQO (refer to QAPP Attachment 1, October 2010). Refer to Worksheet 15 for summary of analytical parameters, associated potential action levels, and quantitation limits.

How much data are needed? (number of samples for each analytical group, matrix, and concentration)

Surface Water PCB Samples: 20 locations \times 1 sample/location \times 1 event = 20 field samples plus associated QC

Porewater PCB Samples: 20 locations \times 2 samples/location \times 1 event = 40 field samples plus associated QC

Porewater VOC Time-Integrated Samples: 20 locations \times 2 sample/location \times 1 event = 40 field samples plus associated QC

Surface Sediment PCB/TOC Samples: 20 locations \times 1 sample/location \times 1 event = 20 field samples plus associated QC (refer to QAPP Modification No. 1, dated April 2011 for collection, processing, and analysis of sediment samples)

Geotechnical Sediment Cores: 10 locations \times 1 core/location \times 3 samples/core \times 1 event = 30 field samples (refer to QAPP, dated October 2010 for collection, processing, and analysis of cores)

** Note that field conditions will determine if passive sampler devices can be securely deployed. If bedrock outcrop is exposed at the bottom of the brook, only a surface water sample will be collected.

Refer to SOP No. 28 for sample design and implementation. Refer to Worksheet 18 and Figure 1 for proposed sampling locations.

Where, when, and how should the data be collected/generated?

Where: Bound Brook (Middlesex County, New Jersey) adjacent to the former CDE facility

When: May 2012 through September 2012

How: Refer to SOP No. 28 for sample design and implementation. Sediment samples will be collected following method and procedures provided in QAPP Modification No. 1 (dated April 2011). Geotechnical cores will be collected following method and procedures provided in QAPP (dated October 2010).

Who will collect and generate the data?

Project Team field personnel will collect the samples. The samples will be analyzed for chemical analytical parameters by subcontract laboratories (Axys Analytical Services and Lancaster Laboratories). Porewater and surface water conversion calculations will be conducted by Project Team and subcontractor (Dr. Gschwend of MIT).

How will the data be reported?

Field records (including but not limited to field conditions, field measurements, and coordinates) will be recorded on field sheets following Worksheet 26.

Passive Samplers: Laboratory EDD and data packages for PCB congeners (porewater and surface water) will be reported and validated in units of mass of each PCB congener per mass of polyethylene sampler (pg/g sampler). Analytical data will be reported according to the requirements in Worksheet 29; data validation of laboratory analytical results will follow requirements provided in Worksheets 34 through 36. Project Team will collaborate with Dr. Philip Gschwend's laboratory at MIT to convert passive sampler data to units of concentration (pg/L) using established methods and equilibrium equations that are documented in the literature (refer to attached literature references). For validated data flagged as estimated or nondetected, the sample-specific quantitation limit will be used in the conversion, and porewater concentrations will then be reported as 'equal to or less than' the converted value. Verification of unit conversion from mass per sampler to concentration (pg/L) will be completed. A separate report containing final PCB porewater concentrations will be submitted to the USACE and USEPA for use.

An overview of the passive sampler data conversion to porewater or surface water concentrations is described below. PCB concentration in the porewater or surface water will be calculated using the equilibrium equations: $C_{\text{aqueous}} = C_{\text{sampler}}/K_{\text{sampler-aqueous}}$ where C_{aqueous} is the contaminant concentration in the aqueous phase (either porewater or surface water in pg/L water), C_{sampler} is the contaminant mass in the polyethylene sampler (pg/kg polyethylene), and $K_{\text{sampler-aqueous}}$ is the polyethylene/water partitioning coefficient (L/kg). These partitioning coefficients are available in the literature. For PCB congeners where a polyethylene/water partitioning coefficient has not been reported directly in the literature, it can be estimated based on correlation equations using the PCB congener-specific water solubility or octanol/water partitioning

coefficient (refer to Attachment 2 for literature references, specifically Lohmann R, Environ. Sci. Technol. 2012, vol 46, p 606-618). The usage of partitioning coefficients assumes that the contaminant of interest is in equilibrium between the aqueous phase and the polyethylene sampler. In the laboratory, equilibration experiments with polyethylene have been conducted over periods of up to 60 days; however, because these polymer materials cannot be generally assumed to equilibrate with intact sediments in the field, performance reference surrogates are needed (refer to Worksheet 23). These reference surrogates have been used in passive samplers to shorten deployment times by allowing mass transfer coefficient to be gauged and modeled (refer to Attachment 2 for literature references, specifically Fernandez LA, Environ. Sci. Technol. 2009, vol 43, p 1430-1436). For this project, a 30-day deployment period of the passive samplers has been selected based on professional judgment. While it is understood that longer deployment times will yield less uncertainty because the sampler is closer to equilibrium with the porewater or surface water, a 30-day deployment period was selected as a compromise between balancing the project schedule with obtaining usable data with minimal uncertainty. It is anticipated that after the 30-day deployment, a fraction of the performance reference surrogates in the polyethylene sampler will diffuse out of the sampler (while target compounds diffuse into the sampler). Using a mass transfer model and knowing the fraction of performance reference surrogate lost from the sampler, the equilibrium concentration of each target PCB congeners in the sampler will be estimated. The same mass transfer model approach will be used for evaluating the polyethylene material exposed to porewater and surface water; the difference will be the diffusivity. Note that field data will reveal the fractional approach to equilibrium of the performance reference surrogates. These data will be used in a MATLAB mass transfer software program available through the MIT laboratory to estimate the fractional approach to equilibrium of the other PCB congeners. (MATLAB output will be provided in final report to the USACE and USEPA for use.) The resultant fractional approaches to equilibrium for each congener will then be used to convert the measured congener concentrations to the values they would have achieved had enough deployment time been used to reach polyethylene-porewater equilibrium.

Sediments: Laboratory EDD and data packages for PCB congeners and TOC (sediment) will be reported and validated in units of concentration (mass of contaminant per mass of dry sediment). Analytical data will be reported according to the requirements in Worksheet 29; data validation will follow requirements provided in Worksheets 34 through 36 (refer to QAPP Modification No. 1, dated April 2011).

Aqueous: Laboratory EDD and data packages for VOC analytes will be reported and validated in units of concentration (mass of contaminant per liter of water). Analytical data will be reported according to the requirements in Worksheet 29; data validation will follow requirements provided in Worksheets 34 through 36.

Geotechnical Cores: Laboratory EDD and data packages for geotechnical parameters will be reported in the appropriate physical unit. These parameters do not require data validation per QAPP (dated October 2010).

Validated data will be provided to the USEPA as a MEDD deliverable (formatted consistent with the requirements outlined in USEPA website: <http://www.epa.gov/Region2/superfund/medd.htm>). Analytical data packages will be submitted for each sampling event. Field observations will be recorded on field sheets (refer to Worksheet 26 for more details on field sheets).

How will the data be archived?

Electronic data (MEDD deliverables and applicable Microsoft Excel spreadsheets containing validated data) and copies of laboratory reports will be provided to the USEPA and USACE. A copy of this material will be kept in the Berger project files. The length of time that records will be archived will be at the discretion of the USACE and USEPA.

QAPP Worksheet 12 Measurement Performance Criteria

Matrix	Polyethylene (Passive Sampler)				
Analytical Group	PCB Congeners				
Concentration Level	Low				
Sampling Procedure	Analytical Method/SOP	DQIs	Measurement Performance Criteria¹	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Porewater and Surface Water Samples	USEPA Method 1668C Axys Analytical Services SOP MLA-010 (Revision 11, October 2011) ²	Accuracy	Per Axys SOP MLA-010	Initial Calibration	A
		Accuracy	Per Axys SOP MLA-010	Calibration Verification	A
		Accuracy	Per recoveries given in Axys SOP MLA-010	LCS	A
		Sensitivity/Accuracy	Per Axys SOP MLA-010	MB	A
		Sensitivity	Per Axys SOP MLA-010	MDL	A
		Sensitivity/Accuracy	≤ QL; corrective action will only be implemented if lowest field sample concentration is <10x QL	Polyethylene Trip Blanks (refer to Note 3)	S & A
		Verify surrogate loading and confirm absence of background native compound	Minimum of 75% of target surrogate loading (refer to Worksheet 23 for PCB cocktail)	Polyethylene Matrix Blank (refer to Note 3)	A
		Precision	RPD ≤ 40% if reported values are >5x QL; otherwise ABS < ±QL	Laboratory Replicate	A
		Precision	RPD ≤ 50% if reported values are >5x QL; otherwise ABS < ±QL	Field Co-locates	S & A
		Completeness	>90% sample collection >90% laboratory analysis	Data Completeness Check	S & A

1. The assigned laboratory must perform and meet all the quality assurance elements specified in USEPA Method 1668C or Axys SOP MLA-010, including: performance of initial and ongoing precision and recovery, calibration verification, addition of internal standards, analyses of blanks and determination of detection limits.
2. Axys SOP MLA-010 is based on USEPA Method 1668 Version C.
3. Refer to Worksheet 20 for description of polyethylene matrix blank and trip blanks. Refer to Worksheet 19 and 23 on sample preparation - each sample will be shipped as two 2.5 cm × 5 cm sheets. One of these two sheets will be archived at the laboratory in case a re-analysis is required.
4. PCB congeners, TOC, and geotechnical parameters in sediment samples will be collected and processed according to the methods and performance criteria

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defined in QAPP (dated October 2010) and QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, PCB sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).

QAPP Worksheet 12 Measurement Performance Criteria

Matrix	Porewater (Aqueous)				
Analytical Group	Volatile Organic Compounds				
Concentration Level	Low				
Sampling Procedure	Analytical Method/SOP	DQIs	Measurement Performance Criteria¹	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Porewater Sample	SW-846 Method 8260B Lancaster Laboratories, Inc. SOP 2898 (Revision 18, May 2012) ²	Accuracy	Peak areas within -50% to +100% of the area in the associated reference standard. Retention time within 30s of RT for associated reference standard.	Internal Standards	A
		Accuracy	Per acceptance criteria in Lancaster Laboratories SOP, Section E	CCV/CCB	A
		Sensitivity/Accuracy	≤ QL	MB	A
		Accuracy	All % recoveries must fall within statistically derived QC limits per Lancaster Laboratories SOP	Surrogate Recovery	A
		Accuracy	Per recoveries and %RPD requirements in Lancaster Laboratories SOP for individual VOC analytes	LCS/LCSD	A
		Accuracy/Precision	Per recoveries and %RPD requirements in Lancaster Laboratories SOP for individual VOC analytes	MS/MSD	A
		Sensitivity/Accuracy	≤ QL; corrective action will only be implemented if lowest field sample concentration is <10x QL	Trip Blank (refer to Note 3)	S & A
		Precision	RPD ≤ 50% if reported values are >5x QL; otherwise ABS < ±QL	Field Co-locates	S & A
		Completeness	>90% sample collection >90% laboratory analysis	Data Completeness Check	S & A

1. The assigned laboratory must perform and meet all the quality assurance elements specified in USEPA Method 8260B or Lancaster SOP 2898, including: instrument conditioning (Section A of SOP), tuning (Section B of SOP), analyses of blanks, and determination of detection limits.

2. Lancaster SOP 2898 is based on SW-846 Method 8260 Version B.

3. Refer to Worksheet 20 for description of trip blank.

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QAPP Worksheet 15 – Reference Limits and Evaluation Tables

Matrix: Porewater and Surface Water (Passive Sampler)

Analytical Group: PCB Congeners

Concentration Level: Low

Analyte	CAS Number	Units ¹	Project Action Level ²	Project QL (units of pg/sampler) ³	Analytical Method		Achievable Laboratory Limits (units of pg/sampler)	
					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 1	2051-60-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 2	2051-61-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 3	2051-62-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 4	13029-08-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 5	16605-91-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 6	25569-80-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 7	33284-50-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 8	34883-43-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 9	34883-39-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 10	33146-45-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 11	2050-67-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 12 (Coelutes with PCB 13)	2974-92-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	2.0	8.0
PCB 13 (Coelutes with PCB 12)	2974-90-5	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	2.0	8.0
PCB 14	34883-41-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 15	2050-68-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	2.0	4.0
PCB 16	38444-78-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 17	37680-66-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 18 (Coelutes with PCB 30)	37680-65-2	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 19	38444-73-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 20 (Coelutes with PCB 28)	38444-84-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 21 (Coelutes with PCB 33)	55702-46-0	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 22	38444-85-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 23	55720-44-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

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					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 24	55702-45-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 25	55712-37-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 26 (Coelutes with PCB 29)	38444-81-4	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 27	38444-76-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 28 (Coelutes with PCB 20)	7012-37-5	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 29 (Coelutes with PCB 26)	15862-07-4	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 30 (Coelutes with PCB 18)	35693-92-6	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 31	16606-02-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 32	38444-77-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 33 (Coelutes with PCB 21)	38444-86-9	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 34	37680-68-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 35	37680-69-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 36	38444-87-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 37	38444-90-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 38	53555-66-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 39	38444-88-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 40 (Coelutes with PCB 41 and 71)	38444-93-8	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 41 (Coelutes with PCB 40 and 71)	52663-59-9	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 42	36559-22-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 43	70362-46-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 44 (Coelutes with PCB 47 and 65)	41464-39-5	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 45 (Coelutes with PCB 51)	70362-45-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 46	41464-47-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 47 (Coelutes with PCB 44 and 65)	2437-79-8	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0

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					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 48	70362-47-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 49 (Coelutes with PCB 69)	41464-40-8	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 50 (Coelutes with PCB 53)	62796-65-0	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 51 (Coelutes with PCB 45)	68194-04-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 52	35693-99-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PBB 53 (Coelutes with PCB 50)	41464419	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 54	15968-05-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 55	74338-24-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 56	41464-43-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 57	70424-67-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 58	41464-49-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 59 (Coelutes with PCB 62 & 75)	74472-33-6	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 60	33025-41-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 61 (Coelutes with PCB 70, 74, and 76)	33284-53-6	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 62 (Coelutes with PCB 59 and 75)	54230-22-7	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 63	74472-34-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 64	52663-58-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 65 (Coelutes with PCB 44 and 47)	33284-54-7	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 66	32598-10-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 67	73575-53-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 68	73575-52-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 69 (Coelutes with PCB 49)	60233-24-1	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 70 (Coelutes with PCB 61, 74, and 76)	32598-11-1	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0

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					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 71 (Coelutes with PCB 40 and 41)	41464-46-4	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 72	41464-42-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 73	74338-23-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 74 (Coelutes with PCB 61, 70, and 76)	32690-93-0	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 75 (Coelutes with PCB 59 and 62)	32598-12-2	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 76 (Coelutes with PCB 61, 70, and 74)	70362-48-0	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 77	32598-13-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 78	70362-49-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 79	41464-48-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 80	33284-52-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 81	70362-50-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 82	52663-62-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 83 (Coelutes with PCB 99)	60145-20-2	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 84	52663-60-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 85 (Coelutes with PCB 116 and 117)	65510-45-4	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 86 (Coelutes with PCB 87, 97, 108, 119, and 125)	55312-69-1	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 87 (Coelutes with PCB 86, 97, 108, 119, and 125)	38380-02-8	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 88 (Coelutes with PCB 91)	55215-17-3	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 89	73575-57-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 90 (Coelutes with PCB 101 and 113)	68194-07-0	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 91 (Coelutes with PCB 88)	68194-05-8	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 92	52663-61-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

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					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 93 (Coelutes with PCB 95, 98, 100, and 102)	73575-56-1	pg/sampler	NA	20.0	Per USEPA 1668	Per USEPA 1668	1.0	20.0
PCB 94	73575-55-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 95 (Coelutes with PCB 93, 98, 100, and 102)	38379-99-6	pg/sampler	NA	20.0	Per USEPA 1668	Per USEPA 1668	1.0	20.0
PCB 96	73575-54-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 97 (Coelutes with PCB 86, 87, 108, 119, and 125)	41464-51-1	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 98 (Coelutes with PCB 93, 95, 100, and 102)	60233-25-2	pg/sampler	NA	20.0	Per USEPA 1668	Per USEPA 1668	1.0	20.0
PCB 99 (Coelutes with PCB 83)	38380-01-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 100 (Coelutes with PCB 93, 95, 98, and 102)	39485-83-1	pg/sampler	NA	20.0	Per USEPA 1668	Per USEPA 1668	1.0	20.0
PCB 101 (Coelutes with PCB 90 and 113)	37680-73-2	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 102 (Coelutes with PCB 93, 95, 98, and 100)	68194-06-9	pg/sampler	NA	20.0	Per USEPA 1668	Per USEPA 1668	1.0	20.0
PCB 103	60145-21-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 104	56558-16-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 105	32598-14-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 106	70424-69-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 107 (Coelutes with PCB 124)	70424-68-9	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 108 (Coelutes with PCB 86, 87, 97, 119, and 125)	70362-41-3	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 109	74472-35-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 110 (Coelutes with PCB 115)	38380-03-9	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 111	39635-32-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 112	74472-36-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 113 (Coelutes with PCB 90 and 101)	68194-10-5	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 114	74472-37-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

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Analyte	CAS Number	Units ¹	Project Action Level ²	Project QL (units of pg/sampler) ³	Analytical Method		Achievable Laboratory Limits (units of pg/sampler)	
					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 115 (Coelutes with PCB 110)	74472-38-1	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 116 (Coelutes with PCB 85 and 117)	18259-05-7	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 117 (Coelutes with PCB 85 and 116)	68194-11-6	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 118	31508-00-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 119 (Coelutes with PCB 86, 87, 97, 108, and 125)	56558-17-9	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 120	68194-12-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 121	56558-18-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 122	76842-07-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 123	65510-44-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 124 (Coelutes with PCB 107)	70424-70-3	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 125 (Coelutes with PCB 86, 87, 97, 108, and 119)	74472-39-2	pg/sampler	NA	24.0	Per USEPA 1668	Per USEPA 1668	1.0	24.0
PCB 126	57465-28-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 127	39635-33-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 128 (Coelutes with PCB 166)	38380-07-3	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 129 (Coelutes with PCB 138, 160, and 163)	55215-18-4	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 130	52663-66-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 131	61798-70-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 132	38380-05-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 133	35694-04-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 134 (Coelutes with PCB 143)	52704-70-8	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 135 (Coelutes with PCB 151 and 154)	52744-13-5	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 136	38411-22-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 137	35694-06-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

Title: Field Modification No. 6
Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

Analyte	CAS Number	Units ¹	Project Action Level ²	Project QL (units of pg/sampler) ³	Analytical Method		Achievable Laboratory Limits (units of pg/sampler)	
					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 138 (Coelutes with PCB 129, 160, and 163)	35065-28-2	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 139 (Coelutes with PCB 140)	56030-56-9	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 140 (Coelutes with PCB 139)	59291-64-4	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 141	52712-04-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 142	41411-61-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 143 (Coelutes with PCB 134)	68194-15-0	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 144	68194-14-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 145	74472-40-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 146	51908-16-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 147 (Coelutes with PCB 149)	68194-13-8	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 148	74472-41-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 149 (Coelutes with PCB 147)	38380-04-0	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 150	68194-08-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 151 (Coelutes with PCB 135 and 154)	52663-63-5	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 152	68194-09-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 153 (Coelutes with PCB 168)	35065-27-1	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 154 (Coelutes with PCB 135 and 151)	60145-22-4	pg/sampler	NA	12.0	Per USEPA 1668	Per USEPA 1668	1.0	12.0
PCB 155	33979-03-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 156 (Coelutes with PCB 157)	38380-08-4	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 157 (Coelutes with PCB 156)	69782-90-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 158	74472-42-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 159	39635-35-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 160 (Coelutes with PCB 129, 138, and 163)	41411-62-5	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	1.0	16.0
PCB 161	74472-43-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

Title: Field Modification No. 6
Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

Analyte	CAS Number	Units ¹	Project Action Level ²	Project QL (units of pg/sampler) ³	Analytical Method		Achievable Laboratory Limits (units of pg/sampler)	
					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 162	39635-34-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 163 (Coelutes with PCB 129, 138, and 160)	74472-44-9	pg/sampler	NA	16.0	Per USEPA 1668	Per USEPA 1668	16.0	1.0
PCB 164	74472-45-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 165	74472-46-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 166 (Coelutes with PCB 128)	41411-63-6	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 167	52663-72-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 168 (Coelutes with PCB 153)	59291-65-5	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 169	32774-16-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 170	35065-30-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 171 (Coelutes with PCB 173)	52663-71-5	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 172	52663-74-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 173 (Coelutes with PCB 171)	68194-16-1	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 174	38411-25-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 175	40186-70-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 176	52663-65-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 177	52663-70-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 178	52663-67-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 179	52663-64-6	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 180 (Coelutes with PCB 193)	35065-29-3	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 181	74472-47-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 182	60145-23-5	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 183 (Coelutes with PCB 185)	52663-69-1	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 184	74472-48-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 185 (Coelutes with PCB 183)	52712-05-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 186	74472-49-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 187	52663-68-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

Analyte	CAS Number	Units ¹	Project Action Level ²	Project QL (units of pg/sampler) ³	Analytical Method		Achievable Laboratory Limits (units of pg/sampler)	
					MDLs	Method QLs	EDLs ⁴	QLs ⁴
PCB 188	74487-85-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 189	39635-31-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 190	41411-64-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 191	74472-50-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 192	74472-51-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 193 (Coelutes with PCB 180)	69782-91-8	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 194	35694-08-7	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 195	52663-78-2	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 196	42740-50-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 197 (Coelutes with PCB 200)	33091-17-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 198 (Coelutes with PCB 199)	68194-17-2	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 199 (Coelutes with PCB 198)	52663-75-9	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 200 (Coelutes with PCB 197)	52663-73-7	pg/sampler	NA	8.0	Per USEPA 1668	Per USEPA 1668	1.0	8.0
PCB 201	40186-71-8	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 202	2136-99-4	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 203	52663-76-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 204	74472-52-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 205	74472-53-0	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 206	40186-72-9	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 207	52663-79-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 208	52663-77-1	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0
PCB 209	2051-24-3	pg/sampler	NA	4.0	Per USEPA 1668	Per USEPA 1668	1.0	4.0

1. Laboratory will report final results in units of mass of each PCB congener per mass of polyethylene sampler (pg/g sampler). Project team along with Dr. Gschwend (MIT) will convert units to concentration (pg/L) using existing partitioning equations and available sediment geotechnical data. The final PCB aqueous concentrations will represent a time-integrated, non-colloidal bound, dissolved-phase concentration.
2. USEPA has not approved project-specific action limits for these parameters in porewater. Differences in laboratory detection limits will be considered when comparing the data.
3. The project quantitation limits are equal to the laboratory achievable QLs (Axys Analytical Services).

4. The laboratory achievable EDLs and QLs were determined by Axys Analytical by HRGC/HRMS. Laboratory results will be in dry weight; depending on the sample matrix effects, the actual laboratory QLs may differ.

5. PCB congeners, TOC, and geotechnical parameters in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP (dated October 2010) and QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).

EDL = The EDL (estimated detection limit) is based on Axys Analytical "Sample Detection Limits," which are determined by converting the area equivalent of 2.5 times the estimated chromatographic noise height to a concentration in the same manner that target peak responses are converted to final concentrations; determined individually for every sample analysis run; accounts for any effect of matrix on the detection system and for recovery achieved through the analytical work-up.

QL = The QL (quantitation limit) is based on Axys Analytical "Quantification Limits" which are defined as the lowest concentration that can be quantified with a defined degree of accuracy and is equivalent to the lowest calibration standard above the MDL.

QAPP Worksheet 15 – Reference Limits and Evaluation Tables

Matrix: Porewater (Aqueous)

Analytical Group: Volatile Organic Compounds

Concentration Level: Low

Analyte ¹	CAS Number	Units (µg/L) ²	Project Action Level ³	Project QL (units of µg/L) ⁴	Analytical Method		Achievable Laboratory Limits (units of µg/L)	
					MDLs	Method QLs	MDLs ⁵	QLs ⁵
Dichlorodifluoromethane	75-71-8	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	2	5
Chloromethane	74-87-3	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Vinyl Chloride	75-01-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Bromomethane	74-83-9	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Chloroethane	75-00-3	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Trichlorofluoromethane	75-69-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	2	5
1,1-Dichloroethene	75-35-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	10	Per Method SW-846 8260	Per Method SW-846 8260	2	10
Carbon Disulfide	75-15-0	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Methyl Acetate	79-20-9	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Methylene Chloride	75-09-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	2	5
trans-1,2-Dichloroethene	156-60-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
1,1-Dichloroethane	75-34-3	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
cis-1,2-Dichloroethene	156-59-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5

Title: Field Modification No. 6
Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

Analyte ¹	CAS Number	Units (µg/L) ²	Project Action Level ³	Project QL (units of µg/L) ⁴	Analytical Method		Achievable Laboratory Limits (units of µg/L)	
					MDLs	Method QLs	MDLs ⁵	QLs ⁵
Bromochloromethane	74-97-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Chloroform	67-66-3	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
1,1,1-Trichloroethane	71-55-6	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
Cyclohexane	110-82-7	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	2	5
Carbon Tetrachloride	56-23-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Benzene	71-43-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.5	5
1,2-Dichloroethane	107-06-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,4-Dioxane	123-91-1	µg/L	NA	250	Per Method SW-846 8260	Per Method SW-846 8260	70	250
Trichloroethene	79-01-6	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Methylcyclohexane	108-87-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,2-Dichloropropane	78-87-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Bromodichloromethane	75-27-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
cis-1,3-Dichloropropene	10061-01-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Toluene	108-88-3	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.7	5
trans-1,3-Dichloropropene	10061-02-6	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,1,2-Trichloroethane	79-00-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5

Title: Field Modification No. 6
Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

Analyte ¹	CAS Number	Units (µg/L) ²	Project Action Level ³	Project QL (units of µg/L) ⁴	Analytical Method		Achievable Laboratory Limits (units of µg/L)	
					MDLs	Method QLs	MDLs ⁵	QLs ⁵
Tetrachloroethene	127-18-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
Dibromochloromethane	124-48-1	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,2-Dibromoethane	106-93-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Chlorobenzene	108-90-7	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
Ethylbenzene	100-41-4	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
o-Xylene	95-47-6	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
m,p-Xylenes	N/A	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	0.8	5
Styrene	100-42-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Bromoform	75-25-2	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
Isopropylbenzene	98-82-8	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,3-Dichlorobenzene	541-73-1	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,4-Dichlorobenzene	106-46-7	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,2-Dichlorobenzene	95-50-1	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5
1,2Dibromo-3-chloropropane	96-12-8	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	2	5
1,2,4-Trichlorobenzene	120-82-1	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5

Analyte ¹	CAS Number	Units (µg/L) ²	Project Action Level ³	Project QL (units of µg/L) ⁴	Analytical Method		Achievable Laboratory Limits (units of µg/L)	
					MDLs	Method QLs	MDLs ⁵	QLs ⁵
1,2,3-Trichlorobenzene	87-61-6	µg/L	NA	5	Per Method SW-846 8260	Per Method SW-846 8260	1	5

1. VOC analyte list includes TCL VOC analytes (listed in version 4.3) plus bromochloromethane, 1,4-dioxane, 1,2,3-trichlorobenzene, and the individual xylene compounds to be consistent with the OU4 QAPP (dated October 2010). Ketones, ethers, alcohols, acetone, and MTBE were removed from the VOC analyte list to account for polyethylene sampling techniques. Compounds removed include: 2-Hexanone, 4-Methyl-2-pentanone, and 2-Butanone.
2. Laboratory will report porewater concentrations in units of µg/L.
3. USEPA has not approved project-specific action limits for these parameters in porewater. Differences in laboratory detection limits will be considered when comparing the data.
4. The project quantitation limits are equal to the laboratory achievable QLs (Lancaster Laboratories).
5. The laboratory achievable MDLs and QLs listed were determined by Lancaster Laboratories using GC/MS. Laboratory will report down to the MDL.

MDL = The MDL (method detection limit) is based on two values from Lancaster Laboratories. The MDL (calculated) is the minimum concentration of a substance that can be measured with 99% confidence that the analyte concentration is greater than zero. It is determined from analysis of a sample containing the analyte, on a given instrument, per column and detector. The MDL (reported) is the highest of all calculated MDL's obtained from all instruments, used for a particular method/matrix. This MDL value can be the actual value or a default value set above the calculated MDL value. Use of a default value reduces slight changes in reported MDL's from year to year and helps maintain consistent reporting levels.

QL = The QL (quantitation limit) is based on Lancaster Laboratories LOQ (Level of Quantitation), which is the level above which quantitative results may be obtained with a specified degree of confidence. Lancaster Laboratories' policy is to set the LOQ at approximately three times the MDL. For analyses with calibration curves, the low point of the curve must be at or below the LOQ.

QAPP Worksheet 17

Sampling Process Design

Stream Flow/Water Quality Survey

The stream flow/water quality survey encompasses a two-part field program. The first sampling event was conducted on May 7-8, 2012 (following partial QAPP approval from the USACE and USEPA) between RM5.7 (at the confluence of Bound Brook and Cedar Brook) and RM7.0, which is located upstream of Belmont Avenue Bridge. The objective of this initial survey was to identify areas of potential groundwater discharge using (1) stream flow measurements (collected along transects that were spaced 200 feet apart) and water quality measurements (collected along transects that were spaced approximately 100 feet apart). This survey encompassed the groundwater modeling “reach” area (refer to Figure 1). The results of the May 2012 stream flow survey showed a slow increase in flow in the downstream direction between RM7.0 and 5.7. However, no significant increase over short stretches of the stream was observed. This slow increase in flow downstream is consistent with diffuse groundwater discharge rather than large point discharges, such as discrete springs. The results of the May 2012 water quality survey showed notable variations in water quality parameters adjacent to the former CDE facility. The highest variability was observed between the Conrail Railroad tracks/walking bridge at RM6.3 and Lakeview Avenue Bridge at RM6.15. This area corresponds well to the groundwater flow model simulations of likely discharge of contaminated groundwater.

The second sampling event was conducted on June 20-22, 2012. This reconnaissance focused on (1) sediment bed thickness at potential sampling locations and (2) investigating the stretch of brook between RM6.3 and RM6.15 for possible outfall locations or groundwater springs/seeps. The passive sampling equipment requires approximately 12 inches of sediment to be securely deployed in the sediment bed. No discharge points were observed during this reconnaissance, providing another line of evidence that changes in water quality were likely associated with potential diffuse groundwater discharge from the bedrock outcropping in the bed of the brook.

Proposed Sampling Locations

Based on the May 2012 water quality observations and June 2012 field reconnaissance of sediment bed thickness, 20 proposed porewater sampling locations were selected. A summary of potential sampling locations is described below (refer to Worksheet 18 for details and Figure 1).

- Three upstream sampling locations were selected between Talmadge Bridge at RM8.3 and the upstream side of the twin culverts, where Bound Brook passes beneath a former railroad spur, at RM6.55. A passive sampler will be deployed at each sampling location, yielding 3 passive samplers in this upstream area.
- Ten sampling locations were selected within Reaches 1-4 of the OU3 groundwater flux model between the downstream side of the twin culverts at RM6.55 and the Lakeview Avenue Bridge at RM6.15. One or two passive samplers will be deployed at each sampling locations, yielding 15 passive samplers in the modeled area. Note that when two sets of passive sampler are deployed at a potential sampling location, they will represent distinct samples (not co-locates).
- Two downstream sampling locations were selected between Lakeview Avenue Bridge at RM6.15 and downstream of the OU3 groundwater flux model at RM5.8. A passive sampler will be deployed at each sampling location, yielding 2 passive samplers in the downstream area.

Objectives of Field Program

The proposed field plan involves measuring in-situ PCB porewater and surface water concentrations via the deployment of passive samplers (composed of polyethylene) into the sediment beds and water column adjacent to the former CDE facility. The passive sampler deployment will be supplemented with the collection of the following data:

- Porewater VOC Concentrations: Stilling tube (installed to bedrock or refusal) next to each PCB passive sampler. Inside each tube, Berger will deploy either a commercially available VOC passive diffusion bag or a modified VOC vial that will be filled with reagent-grade, analyte-free water and covered with a low-density polyethylene membrane and metal septum cap. (Field-fabricated VOC samplers may be necessary to accommodate field conditions and dimensions of the sampling tubes that can be feasibly installed in the relationship to the thin layer of unconsolidated sediment.) The VOC sampler will remain in the stilling tube for two 2-week deployment allowing dissolved-phase VOC

analytes to partition through the polyethylene membrane and accumulate inside the sampler. The resulting VOC sample will represent a time-integrated, dissolved-phase VOC sample.

- Geotechnical Sediment Cores: Geotechnical data from the sediment bed are required to convert contaminant mass in the passive sampler to porewater and surface water concentrations. Passive samplers located adjacent to a 2011 sediment coring location will take advantage of existing data. For sampling locations that are not adjacent to a 2011 sediment core, an additional geotechnical sediment core will be collected.
- Surface Sediment Samples: Surface sediments (measured at 0-5 cm below the sediment-water interface) are being analyzed for PCB congeners to estimate a site-specific partitioning coefficient in the biologically active zone (assuming that the sediment and porewater are at equilibrium). These data will support the risk assessments in understanding what sediment-bound contaminant burden is bioavailable. (TOC is required to calculate the partitioning coefficient.)

Surface Water PCB Samples: $20 \text{ locations} \times 1 \text{ sample/location} \times 1 \text{ event} = 20 \text{ field samples plus associated QC}$

Porewater PCB Samples: $20 \text{ locations} \times 2 \text{ samples/location} \times 1 \text{ event} = 40 \text{ field samples plus associated QC}$

Porewater VOC Time-Integrated Samples: $20 \text{ locations} \times 2 \text{ sample/location} \times 1 \text{ event} = 40 \text{ field samples plus associated QC}$

Surface Sediment PCB/TOC Samples: $20 \text{ locations} \times 1 \text{ sample/location} \times 1 \text{ event} = 20 \text{ field samples plus associated QC}$ (refer to QAPP Modification No. 1, dated April 2011 for collection, processing, and analysis of sediment samples)

Geotechnical Sediment Cores: $10 \text{ locations} \times 1 \text{ core/location} \times 3 \text{ samples/core} \times 1 \text{ event} = 30 \text{ field samples}$ (refer to QAPP, dated October 2010 for collection, processing, and analysis of cores)

** Note that field conditions will determine if passive sampler devices can be securely deployed. If bedrock outcrop is exposed at the bottom of the brook, only a surface water sample will be collected.

Auxiliary field data that will be collected during deployment/retrieval of passive samplers include:

- Water level elevation and temperature (collected using a Solinst LTC Junior M10 data logger)
- Sediment probing data at each sampling location

Sampling Methods

- SOP No. 06: Procedure to Locate Sample Points Using a Global Positioning System
- SOP No. 07: Procedure for Sediment Probing
- SOP No. 08: Procedure to Collect Push and Piston Cores
- SOP No. 17: Procedure for the Calibration and Operation of a Horiba U-10
- SOP No. 21: Collection and Processing of Surface Sediments

QAPP Worksheet 18

Sampling Locations and Methods/SOP Requirements Table (Worksheet 18)

Sampling Location/ID Number	Matrix	Estimated Penetration Depth (inches)	Analytical Group	Conc Level	Number of Field Samples	Sampling SOP Reference	Rationale of Sampling Location
PW01	Porewater, Surface Water, and Surface Sediment	60 inches	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	Talmadge Bridge (RM8.3) Rationale: upstream of the OU3 groundwater model boundary; study area upstream boundary; no variation in water quality measurements observed.
PW02	Porewater, Surface Water, and Surface Sediment	24 inches (A side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF13/T353 Rationale: upstream of the OU3 groundwater model boundary; no variation in water quality measurements observed.
PW03	Porewater, Surface Water, and Surface Sediment	18 inches (A side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	T350 Rationale: OU3 Reach 1; upstream of twin culvert (100 feet upstream).
PW04 and PW05	Porewater, Surface Water, and Surface Sediment	18 inches on left side of culvert	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF18/T348 Rationale: OU3 Reach 1; downstream of twin culvert, where isolated changes in water quality were observed.
PW06 and PW07	Porewater, Surface Water, and Surface Sediment	12 inches (A side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF20/T346 Rationale: OU3 Reach 1; upstream of OU2 drainage basin, where isolated changes in water quality were observed.
PW08	Porewater, Surface Water, and	12 inches (A side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC	SOP No. 28 and QAPP Modification No. 1 for sediment	SF22/T344 Rationale: OU3 Reach 2 representation.

Sampling Location/ID Number	Matrix	Estimated Penetration Depth (inches)	Analytical Group	Conc Level	Number of Field Samples	Sampling SOP Reference	Rationale of Sampling Location
	Surface Sediment				passive samplers (1 per 2-week deployment), and 1 surface sediment sample	sampling	
PW09 and PW10	Porewater, Surface Water, and Surface Sediment	Sufficient sediment present; depth of penetration not recorded	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF26 Rationale: OU3 Reach 3; isolated changes in conductivity and salinity were observed.
PW11	Surface Water only	Bedrock	PCB and VOC	Low	1 polyethylene passive sampler for surface water and 2 VOC passive samplers (1 per 2-week deployment)	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF28/T337 Rationale: OU3 Reach 3; upstream of railroad bridge. Upstream boundary of significant water quality variations observed between SF30 and SF34.
PW12	Surface Water only	Bedrock	PCB and VOC	Low	1 polyethylene passive sampler for surface water and 2 VOC passive samplers (1 per 2-week deployment)	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF29 Rationale: OU3 Reach 3; downstream of railroad bridge and adjacent to possible discharge point where changes in conductivity and salinity were observed.
PW13 and PW14	Porewater, Surface Water, and Surface Sediment	Sufficient sediment present; depth of penetration not recorded	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF31/T333B Rationale: OU3 Reach 3; significant water quality variations observed (conductivity, salinity, high ORP, and high water temperature).
PW15	Surface Water only	Bedrock	PCB and VOC	Low	1 polyethylene passive sampler for surface water and 2 VOC passive samplers (1 per 2-week deployment)	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF32/T333A Rationale: OU3 Reach 3; significant water quality variations observed (conductivity, salinity, high ORP, and high water temperature).

Sampling Location/ID Number	Matrix	Estimated Penetration Depth (inches)	Analytical Group	Conc Level	Number of Field Samples	Sampling SOP Reference	Rationale of Sampling Location
PW16 and PW17	Porewater, Surface Water, and Surface Sediment	14 inches (B side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF34 Rationale: OU3 Reach 3; significant water quality variations observed (conductivity, salinity, high ORP, and high water temperature).
PW18	Porewater, Surface Water, and Surface Sediment	18 inches (B side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF37/T328 Rationale: OU3 Reach 4; downstream of Lakeview Avenue Bridge. Downstream boundary of significant water quality variations – water quality parameters stabilize.
PW19	Porewater, Surface Water, and Surface Sediment	14 inches (B side)	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF38 Rationale: OU3 Reach 4; downstream of Lakeview Avenue Bridge. Downstream boundary of significant water quality variations.
PW20	Porewater, Surface Water, and Surface Sediment	36 inches	PCB, TOC, and VOC	Low	1 polyethylene passive sampler for porewater and surface water, 2 VOC passive samplers (1 per 2-week deployment), and 1 surface sediment sample	SOP No. 28 and QAPP Modification No. 1 for sediment sampling	SF57/T309 Rationale: downstream of the OU3 groundwater model boundary.

Notes on Worksheet 18

Surface Water PCB Samples: 20 locations \times 1 sample/location \times 1 event = 20 field samples plus associated QC

Porewater PCB Samples: 20 locations \times 2 samples/location \times 1 event = 40 field samples plus associated QC

Porewater VOC Time-Integrated Samples: 20 locations \times 2 sample/location \times 1 event = 40 field samples plus associated QC

Surface Sediment PCB/TOC Samples: 20 locations \times 1 sample/location \times 1 event = 20 field samples plus associated QC (refer to QAPP Modification No. 1, dated April 2011 for collection, processing, and analysis of sediment samples)

Geotechnical Sediment Cores: 10 locations \times 1 core/location \times 3 samples/core \times 1 event = 30 field samples (refer to QAPP, dated October 2010 for collection, processing, and analysis of cores)

** Note that field conditions will determine if passive sampler devices can be securely deployed. If bedrock outcrop is exposed at the bottom of the brook, only a surface water sample will be collected.

QAPP Worksheet 19
Analytical SOP Requirement Table

Analytical SOP Requirements Table							
Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected) ¹	Maximum Holding Time (preparation/analysis)
Porewater and Surface Water (Passive Sampler)	PCB	Low	USEPA Method 1668C	Polyethylene sheet (refer to Note 2)	Polyethylene sheet (refer to Note 2). Ship polyethylene samples in 40 mL amber glass vial with an aluminum foil-lined lid with 1 mL of reagent-grade water to maintain moisture (refer to Note 3)	Rinse polyethylene sheet with reagent-grade water; slice and process polyethylene sheet in the field according to SOP No. 28; store samples in 40 mL amber glass vial with an aluminum foil-lined lid with 1 mL of reagent-grade water to maintain moisture (refer to Note 3). Ship and archive at 4±2 degrees Celsius.	1 year if stored at 4±2 degrees Celsius and moisture in vial is maintained
Surface Sediment (refer to Note 5)	PCB	Low	USEPA Method 1668C	45 grams (minimum of 25 grams)	4 oz. glass	Archive and ship frozen at less than -10±2 degrees Celsius	1 year (per USEPA methods)
Surface Sediment (refer to Note 6)	TOC	Low	Modified SW-846 Method 9060	10 grams (minimum of 7 grams)	4 oz. glass	Archive and ship frozen at less than -10±2 degrees Celsius	6 months (per USEPA guidance EPA-905-B02-001-B)
Geotechnical Sediment Cores (refer to Note 7)	Geotechnical Parameters	NA	ASTM D422 ASTM D4318 ASTM D2937 ASTM D2216	Per ASTM method	Undisturbed sample (Core)	Airtight caps to preserve moisture content	None specified
Porewater (Time-integrated Aqueous Samples)	VOC	Low	SW-846 Method 8260B	Commercially available or field-fabricated VOC diffusion sampler (refer to Note 4)	Transfer liquid from sampler to three 40 mL VOC vials with Teflon lined septum	No headspace in vials. Field preserve with HCl to pH<2; ship at 4±2 degrees Celsius within 24 hours of sample collection	14 days from collection to analysis

Notes on Worksheet 19

1. Refer to SOP No. 28 for details on handling and processing polyethylene samples.
2. Exposed polyethylene sheet in the sampler is 5 cm wide × 50 cm long (exposed) × 25 µm thick (low density polyethylene material). Following retrieval of sampler device, Berger field crew will slice polyethylene sheet into discrete samples. Each sample will have the dimensions of 5 cm wide × 5 cm long. Berger field crew will then divide the sample

longitudinally into two pieces (each piece having dimensions of 2.5 cm wide \times 5 cm long). Both pieces will have the same sample identification number but shipped in two separate vials. Samples will be preserved and shipped following the requirements of Worksheet 19. The laboratory will analyze one piece of polyethylene and archive the second piece in case a re-analysis is required. Polyethylene material that is not shipped immediately for analysis will be archived at 4 ± 2 degrees Celsius at the laboratory per Worksheet 19 holding times.

3. MIT laboratory shall provide solvent-clean glass vials and solvent-clean, aluminum foil-lined caps for shipment and storage (solvent clean with dichloromethane).

4. Berger will deploy either a commercially available VOC passive diffusion bag or a modified VOC vial that will be filled with reagent-grade, analyte-free water and covered with a low-density polyethylene cover and metal septum cap.

5. PCB congeners in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).

6. TOC in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). TOC analysis will include TOC and Percent Moisture.

7. Geotechnical parameters in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP (dated October 2010). Geotechnical analysis will include grain size (sieve and hydrometer), Atterburg Limits, bulk density, and percent moisture.

QAPP Worksheet 20

Field Quality Control Sample Summary Table

Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference	No. of Field Samples	No. of Field Co-Located Samples	No. of MS/MSD or Lab Replicate Samples	No. of Polyethylene Matrix Blank	No. Trip Samples or Equipment Blanks	Estimated Total No. of Samples to Lab ⁵
Porewater and Surface Water (Passive Sampler)	PCB	Low	USEPA Method 1668C	60	3 (refer to Note 1)	3	1 (refer to Note 2)	1 deployment trip blank and 1 retrieval trip blank (refer to Note 3)	69 (Polyethylene samples will be analyzed following this QAPP modification)
Surface Sediment (refer to Note 6)	PCB	Low	USEPA Method 1668C	20	1	1	0	1	23 Surface sediment will be collected, processed, and analyzed according to QAPP Modificaiton No. 1 (dated April 2011)
Surface Sediment (refer to Note 7)	TOC	Low	Modified SW-846 Method 9060	20	1	2	0	1	24 Surface sediment will be collected, processed, and analyzed according to QAPP Modificaiton No. 1 (dated April 2011)
Geotechnical Sediment Core (refer to Note 8)	Geotechnical Parameters	NA	ASTM D422 ASTM D4318 ASTM D2937 ASTM D2216	30	0	0	0	0	30 Geotechnical sediment cores will be collected, processed, and analyzed according to QAPP (dated October 2010)
Porewater (Time-integrated Aqueous Samples)	VOC	Low	SW-846 Method 8260B	40 (20 per event)	2 (1 per event)	2 (1 per event)	0	2 trips (1 per event) 2 field blanks (1 per event) (refer to Note 4)	22 (Aqueous samples will be analyzed following this QAPP modification)

Porewater and Surface Water PCB Samples: Total of 60 field samples plus associated QC

Porewater samples = 20 locations × 2 samples/location × 1 event = 40 field samples plus associated QC

Surface Water samples = 20 locations × 1 sample/location × 1 event = 20 field samples plus associated QC

Each passive sampler will target three discrete intervals: (1) the section of polyethylene sheet above the sediment-water interface that is exposed to the surface water, (2) the section of polyethylene sheet that is below the sediment-water interface that is exposed to the porewater in the biologically active zone (0-5 cm), and (3) the bottom 5 cm of the polyethylene sheet (exact depth will vary depending on the penetration depth of the sampler). If bedrock is encountered, this bottom sample will represent the porewater concentrations near the underlying bedrock where groundwater discharges to the sediment. If bedrock is not encountered, this bottom sample will represent the porewater concentration at refusal. (Note that when the sampler frame encounters bedrock, the polyethylene sheet in the sampler will be elevated 8 cm above the bedrock due to the frame construction.)

Porewater VOC Time-Integrated Samples: 20 locations \times 1 sample/location \times 2 event = 40 field samples plus associated QC

Surface Sediment PCB/TOC Samples: 20 locations \times 1 sample/location \times 1 event = 20 field samples plus associated QC (refer to QAPP Modification No. 1, dated April 2011)

Geotechnical Sediment Cores: 10 locations \times 1 core/location \times 3 samples/core \times 1 event = 30 field samples (refer to QAPP, dated October 2010)

** Note that field conditions will determine if passive sampler devices can be securely deployed. If bedrock outcrop is exposed at the bottom of the brook, only a surface water sample will be collected.

Notes on Worksheet 20

1. At one location, a co-located passive sampler will be deployed next to the parent passive sampler (location selected at random from the field crew). Co-located sample will assess the heterogeneity of the sediment bed. The co-located sample will generate three polyethylene samples.
2. One unexposed polyethylene sheet (loaded with field performance PCB standards) will be prepared at the MIT laboratories and shipped directly to Axys Analytical Services. This sample represents time=0 in the equilibrium equation as well as a matrix blank. Sample will remain stored at Axys Analytical Services until analyses (according to Worksheet 19). Note that polyethylene matrix blank will be shipped as two 2.5 cm \times 5 cm sheets (one of these two sheets will be archived at the laboratory in case a re-analysis of the blank is required).
3. The deployment-trip blank will be created on the first day of deployment and will consist of a polyethylene sheet (loaded with field performance PCB standards) that has been exposed in the field during deployment, handled in the field, and processed/shipped according to Worksheet 19. The retrieval-trip blank will be created on the first day of deployment, stored in a cooler for 30 days, returned to the field during retrieval of the samplers, exposed in the field during retrieval, handled, and processed/shipped according to Worksheet 19. Note that each trip blank will be shipped as two 2.5 cm \times 5 cm sheets (one of these two sheets will be archived at the laboratory in case a re-analysis of the blank is required).
4. The VOC field blank for the time-integrated samples will include a VOC passive sampler filled with reagent-grade water, handled in the field, and processed/shipped according to Worksheet 19. The VOC trip blank will be prepared by the laboratory and shipped to the site and returned to the laboratory.
5. Actual number of samples shipped to the laboratory will be dependent on field conditions. Refer to Worksheet 18 on sampling locations; position and number of locations may change following a reconnaissance of the area which may assist in identifying groundwater discharge.
6. PCB congeners in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).
7. TOC in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). TOC analysis will include TOC and Percent Moisture.
8. Geotechnical parameters in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP (dated October 2010). Geotechnical analysis will include grain size (sieve and hydrometer), Atterburg Limits, bulk density, and percent moisture.

QAPP Worksheet 23
Analytical SOP Reference Table

Analytical SOP References Table

Reference	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
PCB Congeners (Polyethylene Sample)	USEPA Method 1668C Laboratory SOP SLA-126 (Revision 01, February 2012) "Extraction of Polyethylene Strip Sampling Devices" Laboratory SOP MLA-010 (Revision 11, August 2011) "Analytical Method for the Determination of 209 PCB Congeners"	Definitive	PCB Congeners	HRGC/HRMS	Axys Analytical Services Attention: Georgina Brooks 2045 Mills Road West Sidney, BC Canada V8L5X2 Phone: 250-655-5804	Y (see notes below)
PCB Congeners (Sediment)	USEPA Method 1668C Laboratory SOP MLA-010 (Revision 11, August 2011) "Analytical Method for the Determination of 209 PCB Congeners"	Definitive	PCB Congeners	HRGC/HRMS	Axys Analytical Services Attention: Georgina Brooks 2045 Mills Road West Sidney, BC Canada V8L5X2 Phone: 250-655-5804	N
TOC (Sediment)	Modified SW-846 Method 9060 Laboratory SOP 2079 (Revision 12, November 2010) "Determination of TOC and TC in Solids and Sludges by Combustion"	Definitive	TOC	Combustion	Lancaster Laboratories, Inc. Attention: Jill Parker 2425 New Holland Pike Lancaster, PA 17605-2425 Phone: 717-656-2300	N
Percent Moisture (Sediment)	USEPA 160.3 Laboratory SOP 0111 (Revision 10, December 2010) "Moisture Gravimetric"	Definitive	Percent Moisture	Gravimetric	Lancaster Laboratories, Inc. Attention: Jill Parker 2425 New Holland Pike Lancaster, PA 17605-2425 Phone: 717-656-2300	N
Geotechnical Sediment Cores	ASTM D422, Standard Test Method for Grain Size (Sieve and Hydrometer) ASTM D4318, Standard Test Method for Atterburg Limits ASTM D2216 Standard Test Method for Moisture ASTM D4531 Standard Test Method for Density	Screening	Geotechnical Parameters	Refer to ASTM methods	GeoTesting Express, Inc. Attention: Gary T. Torosian 125 Nagog Park Acton, MA 01720 Phone: 978-635-0424	Refer to Worksheet 23 of QAPP (dated October 2010)

Analytical SOP References Table

Reference	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
VOC (Aqueous)	SW-846 Method 8260B Laboratory SOP 2898 (Revision 18, May 2012) "Determination of Volatile Target Compounds and Gasoline Range Organics by Capillary Column Gas Chromatography/Mass Spectrometry in Waters and wastewaers by Method 8260"	Definitive	VOC	GC/MS	Lancaster Laboratories, Inc. Attention: Jill Parker 2425 New Holland Pike Lancaster, PA 17605-2425 Phone: 717-656-2300	N

Laboratory Notes for PCB Congeners in Polyethylene Passive Samplers

1. All laboratory glassware and aluminum foil used to process the polyethylene samples will be decontaminated using a solvent-rinse of dichloromethane.
2. The weight of the pre-spiked, low density polyethylene sheets are approximately 0.8 grams for the entire sheet (5 cm wide × 63 cm long × 25 µm thick).
3. Polyethylene sheets will be spiked by the MIT laboratory with the following field performance PCB (13C labeled) standards: (1) PCB8 (di-PCB), (2) a cocktail solution of PCB31 (tri-PCB), PCB95 (penta-PCB), and PCB153 (hexa-PCB), (3) a cocktail solution of PCB28 (tri-PCB), PCB111 (penta-PCB), and PCB178 (hepta-PCB), and (4) PCB47 (tetra-PCB). Polyethylene sheets will be loaded with the field performance PCB standards in a 2-liter 80:20 methanol:water solution and allowed to equilibrate for one week prior to deployment. The 2-liter spiking solution will contain the following amounts of 13C-labeled PCBs, ~28ug PCB8, ~13ug PCB28/PCB31, ~11ug PCB47, ~8ug PCB95, ~4ug PCB111, ~4ug PCB153, and ~3ug PCB178, resulting in a loading on the polyethylene sheet of ~50ng/g. This will correspond to ~3ng of each PCB standard per 5 cm polyethylene slice.
4. MIT laboratory shall clean polyethylene sheet, load polyethylene sheet with field performance PCB standards, clean aluminum sampling frame, and mount polyethylene sheets into the aluminum sampler. MIT laboratory will retain (and archive according to Worksheet 19) a piece of the loaded polyethylene sheet as a reference of the loaded field performance standards concentrations.
5. Per Worksheet 20, an unexposed but surrogate loaded polyethylene sheet will be prepared and shipped by the MIT laboratory to Axys Analytical Services as a matrix blank. Two additional polyethylene sheets (loaded with field performance surrogates) will be prepared and shipped by the MIT laboratory to the Louis Berger field crew and serve as deployment trip blank and retrieval trip blank (refer to Worksheet 20).
6. Following retrieval of sampler device, Berger field crew will slice polyethylene sheet into discrete samples. Each sample will have the dimensions of 5 cm wide × 5 cm long. Berger field crew will then divide the sample longitudinally into two pieces (each piece having dimensions of 2.5 cm wide × 5 cm long). Both pieces will have the same sample identification number. Samples will be preserved and shipped following the requirement Worksheet 19. The laboratory will analyze one piece of polyethylene and archive the second piece in case a re-analysis is required. Polyethylene material that is not shipped immediately for analysis will be archived at 4±2 degrees Celsius at the laboratory per Worksheet 19 holding times.
7. Once received, laboratory shall dry the polyethylene sheets. Once dry, laboratory shall add recovery surrogates directly to the dry polyethylene sheets prior to extraction.
8. Extraction of polyethylene sheets will occur at room temperature in two (24 hour) dichloromethane solvent:solvent extractions. Following the second 24-hour extraction, glassware will be rinsed at a minimum of two times to ensure that target analyte mass is removed. Dichloromethane extractions will be combined prior to blowdown and analysis. Chamber size for solvent:solvent extraction will be approximately 100 mL to minimize loss of target analyte mass.
9. According to USEPA Method 1668, extracts will be cleaned with a GPC column or alumina column.
10. Since a soxhlet extraction will not be required for the extraction of polyethylene sheets, typically cleanup standards (PCB28, PCB111, and PCB 178) will be used as field performance standards.

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Date: June 2012

11. Laboratory shall monitor and report PCB47 as an additional field performance standard.
12. Laboratory shall dry the extracted polyethylene sheet and record the mass of the extracted polyethylene sheet.

QAPP Worksheet 26

Sample Handling System

All sample handling requirements stated in QAPP (dated October 2010) Worksheet 26 will be incorporated into this Field Modification No. 6 with the following addenda:

- Sample management and chains of custodies will be created using the USEPA SCRIBE software.
- Field notes will be recorded on field sheets provided in SOP No. 28 (porewater passive samplers) and SOP No. 29 (stream flow/water quality survey) in addition to existing 2011 field sheets available for surface sediment sampling, sediment probing, sediment coring, and boring logs.
- Field crew will deploy a water level meter at Belmont Avenue Bridge and the Manmade Dam to record the surface water temperature. Two additional probes will be buried in the sediment beds in the vicinity of the passive samplers to record porewater temperature. Data will be recorded and stored electronically. Data will be downloaded from probes during retrieval of passive samplers.
- Sample Identification Numbers for porewater samples will use the following format based on this example: CDEOU4-120301-PW-T350A0015
 - CDEOU4 = Cornell-Dubilier Electronics Superfund Site – Operable Unit 4
 - 120301 = Collection date with the format year, month, and day (yymmdd)
 - PW = porewater or SW = surface water or GT = Geotechnical core or ED = Ekman Dredge
 - T350A = Transect location corresponding to 2011 sediment probing transects
 - 0015 = Depth of sample in centimeters (i.e., 00-15 centimeters)

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 Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
 Date: June 2012

QAPP Worksheet 28

QC Samples Table for PCB Congeners

Analyte/Matrix	PCB Congeners		Sampler's Name		The Louis Berger Group Field Sampling Crew	
Concentration Level	Low		Field Sampling Organization		The Louis Berger Group Field Sampling Crew	
Sampling SOP	Porewater and Surface Water		Analytical Organization		Axys Analytical Services	
Analytical Method/SOP Reference	USEPA Method 1668C (Axys Analytical SOP MLA-010, Revision 11, August 2011)		No. of Sample Locations		Per Worksheet 20	
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Co-locate	1 per 20 field locations	QAPP	If the limits exceed limits for the field replicate, this will be addressed by the Louis Berger Data Reviewer	Louis Berger	Precision	RPD <50% if reported values are > 5x QL; otherwise ABS < ± QL
Initial Calibration	At initial set up or when corrective is taken which may change calibration per AXYS SOP MLA-010	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Accuracy	Per Axys Analytical SOP MLA-010
Laboratory Replicate	1 per 20 field samples	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Precision	RPD ≤ 40% if reported values are > 5x QL; otherwise ABS < ± QL
Calibration Verification	Prior to every 12 hr. period, but following Column Performance Solution and at end of 12 hr. period per AXYS SOP MLA-010	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Accuracy	Per Axys Analytical SOP MLA-010
LCS	Each group of 20 samples or less prior to analysis of samples	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Accuracy	Per recoveries given in Axys Analytical SOP MLA-010

Title: Field Modification No. 6
 Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
 Date: June 2012

QC Samples Table for PCB Congeners

Analyte/Matrix	PCB Congeners		Sampler's Name	The Louis Berger Group Field Sampling Crew		
Concentration Level	Low		Field Sampling Organization	The Louis Berger Group Field Sampling Crew		
Sampling SOP	Porewater and Surface Water		Analytical Organization	Axys Analytical Services		
Analytical Method/SOP Reference	USEPA Method 1668C (Axys Analytical SOP MLA-010, Revision 11, August 2011)		No. of Sample Locations	Per Worksheet 20		
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Polyethylene Trip Blanks	1 per sampling event (includes Day 1 trip and Day 30 trip)	QAPP	Corrective action will only be implemented if lowest field sample concentration is <10x QL. Corrective Action: reanalyze back-up piece of trip blank to confirm contamination. If blank contamination is confirmed, then data will be flagged by validator to indicate blank contamination.	Assigned lab	Sensitivity/Accuracy	≤ QL; corrective action will only be implemented if lowest field sample concentration is <10x QL

Title: Field Modification No. 6
 Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
 Date: June 2012

QC Samples Table for PCB Congeners

Analyte/Matrix	PCB Congeners		Sampler's Name		The Louis Berger Group Field Sampling Crew	
Concentration Level	Low		Field Sampling Organization		The Louis Berger Group Field Sampling Crew	
Sampling SOP	Porewater and Surface Water		Analytical Organization		Axys Analytical Services	
Analytical Method/SOP Reference	USEPA Method 1668C (Axys Analytical SOP MLA-010, Revision 11, August 2011)		No. of Sample Locations		Per Worksheet 20	
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Polyethylene Matrix Blank	1 per sampling event	QAPP	Laboratory will reanalyze back-up piece of matrix blank. If results are not within targeted surrogate-loading range, laboratory will reference with MIT where an archive piece of the matrix blank will be stored and may be analyzed at request of Project Manager. A minimum of 75% of the target loading is desired in the matrix blank (or time=0 in the mass transfer model) so that subsequent evaluation of field samples after deployment can assess the relative fraction of surrogates lost in the field.	Assigned lab	Verify surrogate loading and confirm absence of background native compound	Minimum of 75% of target loading (refer to Worksheet 23 for PCB cocktail)
MB	Each time samples are extracted	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Sensitivity/Accuracy	Per Axys Analytical SOP MLA-010
MDL	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Per Axys Analytical SOP MLA-010	Assigned lab	Sensitivity	Per Axys Analytical SOP MLA-010

Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

QC Samples Table for PCB Congeners

Analyte/Matrix	PCB Congeners		Sampler's Name		The Louis Berger Group Field Sampling Crew	
Concentration Level	Low		Field Sampling Organization		The Louis Berger Group Field Sampling Crew	
Sampling SOP	Porewater and Surface Water		Analytical Organization		Axy's Analytical Services	
Analytical Method/SOP Reference	USEPA Method 1668C (Axy's Analytical SOP MLA-010, Revision 11, August 2011)		No. of Sample Locations		Per Worksheet 20	
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
<p>1. Assigned laboratory must perform all the QC Sample analyses and meet all the measurement performance criteria, which assess the analytical DQIs specified in USEPA Method 1668C (Axy's SOP MLA-010).</p> <p>2. PCB congeners, TOC, and geotechnical parameters in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP (dated October 2010) and QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).</p>						

Title: Field Modification No. 6
 Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
 Date: June 2012

QAPP Worksheet 28

QC Samples Table for Volatile Organic Compounds

Analyte/Matrix	Volatile Organic Compounds		Sampler's Name	The Louis Berger Group Field Sampling Crew		
Concentration Level	Low		Field Sampling Organization	The Louis Berger Group Field Sampling Crew		
Sampling SOP	Porewater Sample		Analytical Organization	Lancaster Laboratories, Inc.		
Analytical Method/SOP Reference	SW-846 Method 8260B (Lancaster Laboratories, SOP 2898, Revision 18, May 2012)		No. of Sample Locations	Per Worksheet 20		
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Per Lancaster SOP 2898	Per Lancaster SOP 2898	Recalibrate	Assigned laboratory	Accuracy	Peak areas within -50% to +100% of the area in the associated reference standard. Retention time within 30s of RT for associated reference standard.
CCV/CCB	Per Lancaster SOP 2898	Per Lancaster SOP 2898	Recalibrate and reanalyze CCV, CCB, and all associated field samples	Assigned laboratory	Accuracy	Per acceptance criteria in lab SOP, Section E.
MB	1 per 20 samples	Per Lancaster SOP 2898	Re-prepare blanks and reanalyze	Assigned laboratory	Accuracy/Sensitivity	≤ QL
Surrogate Recovery	Per Lancaster SOP 2898	Per Lancaster SOP 2898	Contact Louis Berger to determine if re-extraction/re-analysis and additional clean-up steps are required	Assigned laboratory	Accuracy	All % recoveries must fall within statistically derived QC limits per Lancaster lab SOP
LCS/LCSD	1 per 20 samples	Per Lancaster SOP 2898	Reanalyze	Assigned laboratory	Accuracy	Per recoveries and % RPD requirements in Lancaster laboratories SOP for individual VOC analytes

Title: Field Modification No. 6
Project: Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook
Date: June 2012

QC Samples Table for Volatile Organic Compounds

Analyte/Matrix	Volatile Organic Compounds		Sampler's Name		The Louis Berger Group Field Sampling Crew	
Concentration Level	Low		Field Sampling Organization		The Louis Berger Group Field Sampling Crew	
Sampling SOP	Porewater Sample		Analytical Organization		Lancaster Laboratories, Inc.	
Analytical Method/SOP Reference	SW-846 Method 8260B (Lancaster Laboratories, SOP 2898, Revision 18, May 2012)		No. of Sample Locations		Per Worksheet 20	
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1 per 20 samples	Per Lancaster SOP 2898	Investigate and reanalyze all associated field samples	Assigned laboratory	Accuracy/Precision	Per recoveries and % RPD requirements in Lancaster Lab SOP for individual VOC analytes
Trip Blank	1 per field event	QAPP	Flag data to indicate blank contamination	Assigned laboratory	Accuracy/Sensitivity	≤ QL; corrective action will only be implemented if lowest field sample concentration is <10x QL
Field Co-locate	1 per field event	QAPP	If RPDs exceed limits for the field replicate, this will be addressed by the data reviewer	Louis Berger	Precision	RPD < 50% if reported values are >5x QL; otherwise ABS < ±QL
Assigned laboratory must perform all the QC Sample analyses and meet all the measurement performance criteria, which assess the analytical DQIs specified in the SW-846 Method 8260B.						

QAPP Worksheet 30
Analytical Services Table

Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory (Name and Address, Contact Person, and Telephone Number)	Backup Laboratory
Porewater (Polyethylene)	PCB Congeners	Low	Refer to WS18 on sampling locations. Refer to WS20 for number of samples.	USEPA Method 1668C	21 business days for analysis and 20 days for validation	Axys Analytical Services Attention: Georgina Brooks 2045 Mills Road West Sidney, BC Canada V8L5X2 Phone: 250-655-5801	Not selected
Sediment (refer to Note 1)	PCB Congeners	Low	Refer to WS18 on sampling locations. Refer to WS20 for number of samples.	USEPA Method 1668C	21 business days for analysis and 20 days for validation	Axys Analytical Services Attention: Georgina Brooks 2045 Mills Road West Sidney, BC Canada V8L5X2 Phone: 250-655-5801	Not selected
Sediment (refer to Note 2)	TOC	Low	Refer to WS18 on sampling locations. Refer to WS20 for number of samples.	Modified SW-846 Method 9060	21 business days for analysis and 20 days for validation	Lancaster Laboratories, Inc. Attention: Jill Parker 2425 New Holland Pike Lancaster, PA 17605-2425 Phone: 717-656-2300	Not selected
Geotechnical Sediment Cores (refer to Note 3)	Geotechnical Parameters	NA	Refer to WS18 on sampling locations. Refer to WS20 for number of samples	Per ASTM methods	21 business days for analysis and 20 days for validation	GeoTesting Express, Inc. Attention: Gary T. Torosian 125 Nagog Park Acton, MA 01720 Phone: 978-635-0424	Not selected
Porewater (Aqueous)	VOC	Low	Refer to WS18 on sampling locations. Refer to WS20 for number of samples	SW-846 Method 8260B	21 business days for analysis and 20 days for validation	Lancaster Laboratories, Inc. Attention: Jill Parker 2425 New Holland Pike Lancaster, PA 17605-2425 Phone: 717-656-2300	Not selected

1. PCB congeners in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). However, to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).
2. TOC in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP Modification No. 1 (dated April 2011). TOC analysis will include TOC and Percent Moisture.
3. Geotechnical parameters in sediment samples will be collected, processed, and analyzed according to the methods and performance criteria defined in QAPP (dated October 2010). Geotechnical analysis will include grain size (sieve and hydrometer), Atterburg Limits, bulk density, and moisture.

QAPP Worksheet 36
Validation (Steps IIa and IIb)

All data validation requirements stated in QAPP (dated October 2010) Worksheet 35 and 36 will be incorporated hereinto this Field Modification No. 6 with the following addenda:

- Data validation will include 100 percent validation of all sample delivery groups.
- PCB Polyethylene Samples: Laboratory EDD and data packages for PCB congeners will be reported and validated in units of mass of each PCB congener per mass of polyethylene sampler (pg/g sampler). PCB samples will be validated following the USEPA National Functional Guidelines and Region II Data Validation Standard Operating Procedure HW-46 (Revision 1, September 2008). Verification of unit conversion of validated data from mass per sampler to concentration will be completed. A separate report containing final PCB porewater concentrations will be submitted to the USACE and USEPA for use.
- PCB Sediment Samples: Laboratory EDD and data packages for PCB congeners will be reported and validated in units of concentration according to QAPP Modification No. 1 (dated April 2011). PCB samples will be validated following the USEPA National Functional Guidelines and Region II Data Validation Standard Operating Procedure HW-46 (Revision 1, September 2008). Note that to be consistent with the porewater and surface water samples, sediment samples will be analyzed following USEPA Method 1668C (not Version A, as stated in QAPP Modification No. 1).
- TOC Sediment Samples: Laboratory EDD and data packages for TOC will be reported and validated in units of concentration. TOC will be validated following the USEPA National Functional Guidelines [USEPA 540-04-009, Draft Final, January 2005 (or the latest version) and USEPA 540/R-99/008, October 1999 (or the latest version)]. Percent moisture will not be validated.
- VOC Aqueous Samples: Laboratory EDD and data packages for VOC analytes will be reported and validated in units of concentration. VOC samples will be validated following the USEPA National Functional Guidelines [USEPA 540-04-009, Draft Final, January 2005 (or the latest version) and USEPA 540/R-99/008, October 1999 (or the latest version)].
- Geotechnical Sediment Cores: Physical parameters do not required data validation per QAPP (dated October 2010).

2012May-StreamFlowSurvey

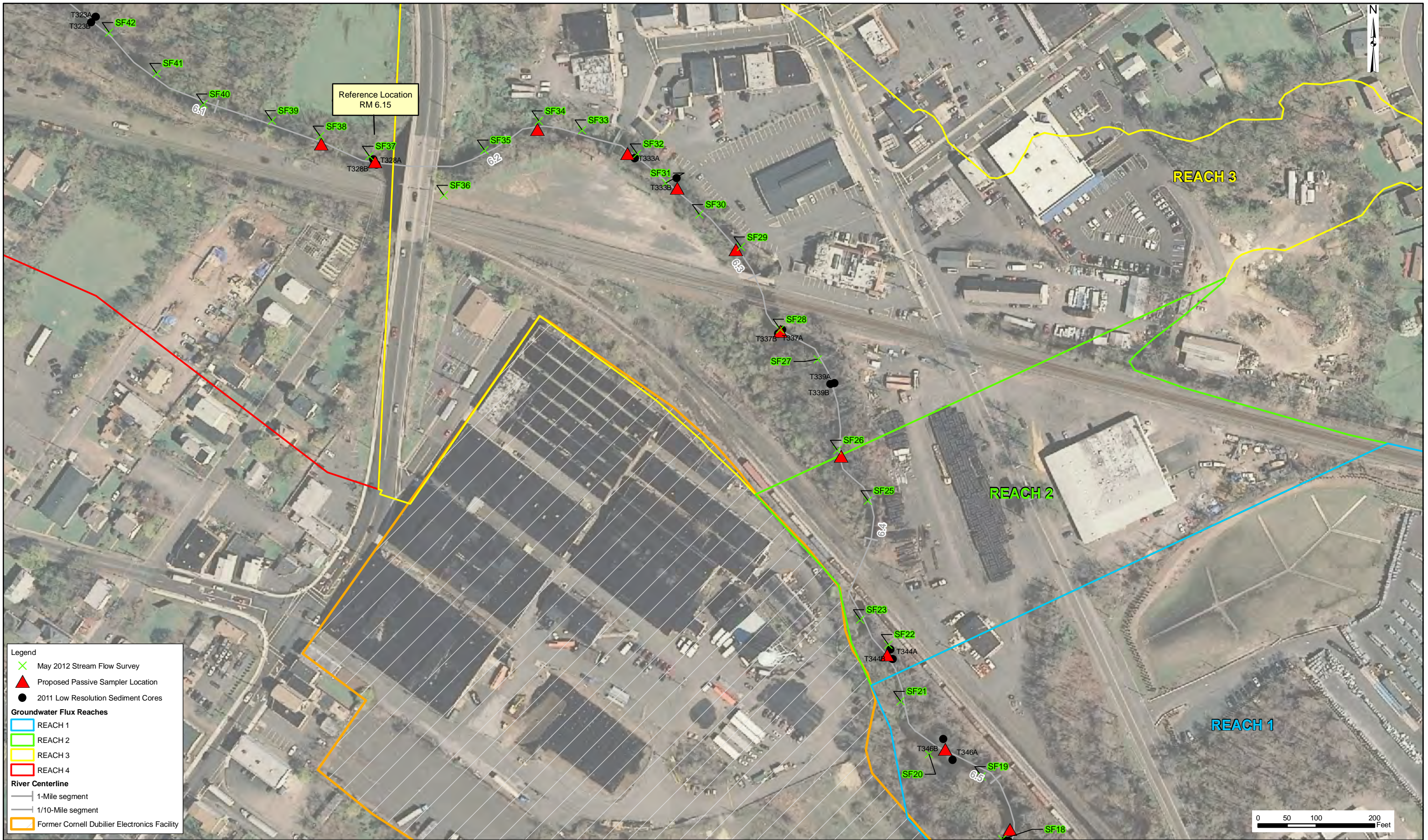


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

May 2012 Stream Flow Transects and Proposed Porewater Sampling Locations
OU4 Remedial Investigation/Feasibility Study

JUNE 2012
Figure 1

2012May-StreamFlowSurvey



Legend

May 2012 Stream Flow Survey

Proposed Passive Sampler Location

2011 Low Resolution Sediment Cores

Groundwater Flux Reaches

REACH 1

REACH 2

REACH 3

REACH 4

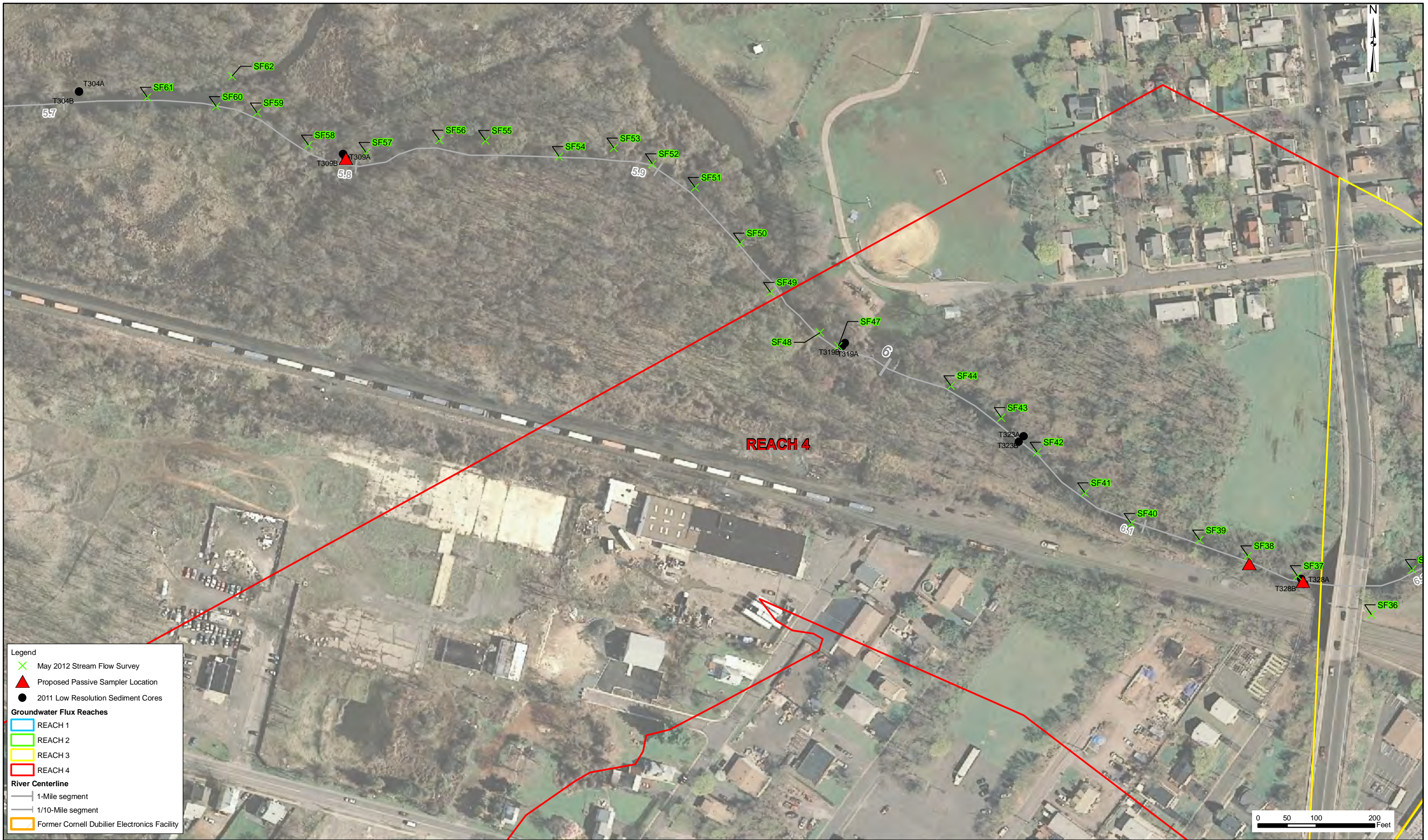
River Centerline

1-Mile segment

1/10-Mile segment

Former Cornell Dubilier Electronics Facility

2012 May-StreamFlowSurvey



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

May 2012 Stream Flow Transects and Proposed Porewater Sampling Locations
OU4 Remedial Investigation/Feasibility Study

JUNE 2012
Figure 3

TITLE: Porewater Contaminant Evaluation Using Polyethylene Passive Samplers and VOC Analysis

I. Introduction

This Standard Operating Procedure (SOP) describes the equipment and methods to be used to conduct in-situ porewater sampling using Polyethylene Passive Samplers during remedial investigation activities at Operable Unit 04 (OU4) of the Cornell-Dubilier Electronics (CDE) Superfund Site. This SOP is designed to not only describe the physical process of installing Polyethylene Passive Samplers, but to familiarize field personnel with the other tasks required for properly assessing and locating/positioning the samplers in the sediment beds. The collection of in-situ data, needed for calculating the estimated porewater concentrations, is also presented here.

II. Equipment and Supplies

- **General Site Work:**
 - Field Notebook
 - GPS
 - Cell Phone
 - Camera
 - Site Map(s) with Proposed Sampling Locations
 - Appropriate Clothing for Entering Water (Summer/Winter)
 - Appropriate PPE (Personal Protective Equipment)
 - Copy of HASP
 - Directions to Hospital
 - Trash Bags
 - Disinfectant Wipes
 - Paper Towels
 - Sharpie Markers/Pens
 - First Aid Kit
- **Sediment Probing:**
 - 8' Probe Rod (Marked in 6" increments)
 - Fiberglass Measuring Tape (100')
 - Spike for Anchoring Measuring Tape
 - Site Specific Data Collection Sheets
 - Soils Charts (Optional)
 - Field Data Sheets
- **Confirmatory and Geotechnical Sediment Cores (During Sediment Probing):**
 - Lexan Core Tubes (~2" diameter)
 - End Caps
 - Expansion Cap

- Plastic Sheetting (For Layout of Sediments)
 - Mallet (18 oz Rubber, or 45 oz Shot-Filled Plastic)
 - Post Driver
 - Soils Jars (For Optional Soils Sample Collection)
 - Hi-Lift Jack and Rubber Coated Steel Cable
 - Field Data Sheets
- Polyethylene Passive Samplers (Provided by Subcontractor):
 - Polyethylene Passive Samplers (Shipped From Subcontractor Wrapped in Aluminum Foil and Properly Packed in Sturdy Plastic Cooler)
 - Metal Frame (Consisting of a 2-Piece Metal “Sandwich” Designed to Securely Hold Polyethylene Membrane – see Figure 1.)
 - Chemically Pre-Treated Polyethylene Membrane Pre-Installed on Decontaminated Metal Frame
 - Adequate number of polyethylene passive samplers for deployment and trip blanks
 - Plexiglas Removable Protective Covers
 - Kim-Wipes for gently removing sediments from the membrane after removal
 - 40 ml Jars for Holding the Polyethylene Membranes After Retrieval for Shipment
 - Scissors (Decontaminated)
 - Decontamination fluids to decon scissors between cuts, and locations
 - Retrieval Line with marker (fishing bobber)
 - 18” (or 10”) Anchoring Spike with line
 - Field Data Sheets
- VOC Sampler (Prepared Prior to Field Deployment):
 - Commercially available Polyethylene Diffusion Bag Samplers (PDBs) (1 per Location) OR:
 - 40 ml VOC Vials¹ (3 Per Location) (opening to be covered with polyethylene membrane)
 - Polyethylene Semi-Permeable Membrane to Cover VOC Vial
 - Stainless Steel Wire, to Tie Membrane to Vials and Act as Retrieval Line After Deployment
 - 40 mL VOC vials with Teflon-lined caps, preserved with Hydrochloric Acid (for final sample from either VOC vial apparatus or PDB)
 - Lab Grade Distilled De-Ionized (DI) Water to Fill VOC Vial or PDB
 - Lexan or stainless steel Core Tube to Prepare Bore Hole
 - Lexan or stainless steel Core Tube 4’ Long (ID Large Enough to Hold 3 40 ml Vials or PDB)
 - Plastic Pipe-Cutter
 - DI Water to fill Lexan or stainless steel tube (1-Gallon Each Location)
 - End Cap with Aluminum Foil Liner (to cover tube)

¹ The VOC acronym is used in this document for both “Volatile Organic Compounds” and “Volatile Organic Analytes”

- Electrical Tape (Type: 3M 33+)
- Weight (Teflon Coated) to Hold Vials or PDB Down in Tube
- Small Diameter Auger (Optional)
- Peristaltic Pump
- Tygon Tubing
- Surface Sediment Sample
 - Ekman bottom sampler with decontaminated Lexan liner
 - Decontaminated stainless steel bowls, spoons and spatulas
 - Sample jars
 - Liquinox, De-ionized water, and organic solvent (e.g., acetone or equivalent) for field decontamination of sampler and liner
- In-Situ data Collection:
 - Levellogger for Depth and Temperature Data Collection (quantity to be determined)
 - Levellogger for Depth, Temperature and Conductivity Data Collection (Optional)
 - Ziploc Bag for Levellogger
 - Levellogger Accessories (Laptop, Download Docking Station)

III. Methods

Polyethylene Passive Samplers – Inspection

The passive samplers will be properly prepared and assembled by the subcontractor (as detailed in their contract; refer to Figure 1 for passive sampler schematic), individually wrapped in clean decontaminated aluminum foil (solvent rinsed or baked overnight in a 450 C degree oven) and shipped to LBG in a properly packed cooler. Cooler(s) will be inspected upon arrival by LBG to determine if the passive samplers are fit for deployment. Any concerns will be addressed immediately by LBG with the subcontractor. Cooler(s) must not be kept on the CDE OU2 Site due to the possibility of onsite airborne PCB contamination compromising the samplers. The cooler shall remain closed except when accessing the samplers. It is not necessary to store the Polyethylene Passive Samplers on ice prior to deployment.

Sediment Probing and Other Assessments: to be Completed at Proposed Locations Immediately Prior to Deployment of Polyethylene Passive Samplers

Each Polyethylene Passive Sampler location shall be evaluated in the field prior to installing the samplers into the riverbed sediments. The sampling locations are those as presented on the Proposed Polyethylene Passive Sampler Deployment Locations Map. GPS coordinates will be provided to the field crew in NJ State Plane Coordinate feet for each Northing and Easting, when available. Sampling locations will be found in the field using a GPS when possible (See SOP No.06: Procedure to Locate Sample Points Using a Global Positioning System). Otherwise, locations will be found relative to existing surveyed river markers (located every 500' along the Bound Brook) by measuring from the survey marker to the

designated former probing/coring transect location along the Bound Brook. While it is desirable to locate Polyethylene Passive Samplers in silt and very fine sand sediments, the riverbed sediments adjacent to the CDE OU2 site, based on previous probing, consist primarily of medium to very coarse sand.

Field data will be recorded in the field notebook or on preprinted field data sheets for this task. GPS coordinates may also be saved into the GPS unit for future download. The width of the brook at the existing water level will be measured, as well as the water depth, and the proposed sampling locations along the former transects will be assessed. Field assessment will consist of probing the sediments to determine material type, unit thicknesses and sediment depth using a smooth probing rod marked in 6" increments (See SOP No.07: Procedure for Sediment Probing). A suitable location will typically consist of a total sediment thickness (to refusal) that is less than the total length of the exposed Polyethylene film plus the length of the metal tip below the Polyethylene film. This maximum total length is 66 cm. Polyethylene passive samples must be deployed so that the upper portion (minimum of 5 cm) of the polyethylene sheet is in contact with the water column, but parallel to the flow direction. Once a suitable location for installing the passive sampler has been determined a confirmatory core will be collected to visually identify the subsurface strata and recorded on the appropriate geotechnical sheets. If necessary, a core may also be collected for geotechnical analysis. Suitable location parameters will be entered into the field notes including thickness of riverbed deposits (as mentioned above), presence of debris/shells or other material, which might rip the Polyethylene membrane during deployment or retrieval, and other site conditions observed while at the transect location. If petroleum odor or sheen is detected at a sampling location the field team will record this information in the field notebook and a phone call to the senior project team will be made to determine the usefulness of installing a Passive Sampler at such a location. If sharp objects or other debris are present, the location will be moved upstream or downstream until a suitable spot free of debris is located, if possible. Additionally, the Passive Sampler may be "sandwiched" between thin Plexiglas sheets during installation to protect the Polyethylene membrane from subsurface rocks and debris. The Plexiglas sheets would then be removed from the sediment bed, by sliding them vertically, leaving behind the Passive sampler for retrieval at a later date. This technique may also be used during retrieval of the passive sampler if it is assessed that damage to the film will not occur in the process.

Sediment probing and the collection of confirmatory cores will be performed as described in the SOP for conducting sediment probing with the following exception: Confirmatory coring will be performed adjacent to every suitable deployment location for every Polyethylene Passive Sampler (SOP states 1 every 10%, which is not the purpose for collecting these confirmatory cores).

Geotechnical sediment cores will need to be collected at 10 sample locations that are not co-located with 2011 sediment coring locations. The geotechnical cores will be collected consistent with methods detailed in SOP No. 08: Procedure to Collect Push and Piston Cores.

Polyethylene Passive Sample Trip Blanks

Two trip blanks will be used during Passive Sampler deployment. A deployment-trip blank will be created on the first day of deployment at one of the deployment locations adjacent to the CDE Site. A Polyethylene Passive Sampler shall be unwrapped and exposed to the air at the sampling location for approximately the same amount of time that the sampler would be in the air from time of being unwrapped until it is submerged in the brook (Note: the trip blank is *not* to be submerged in the brook). A 5 cm long segment of the Polyethylene membrane shall be cut from the trip blank sampler and placed into one of the 40 ml jars, capped (standard cap lined with decontaminated foil) and labeled. Prior to sealing the jar, 1 or 2 milliliters of DI water shall be placed in the jar to maintain 100% humidity in the jar during shipment. The Polyethylene Passive Sampler frame with the remaining Polyethylene still attached to the frame at one end shall be rewrapped and returned to the cooler. A retrieval-trip blank will be created by returning the remaining portion of the sampler to the field during retrieval of the Passive Samplers, exposing the sampler to the air for approximately the same amount of time the sampler would be in the air from the time of retrieval until it is processed. A 5 cm long segment of the Polyethylene membrane shall be cut from the trip blank sampler and placed into one of the 40 ml jars, capped (using a cap lined with decontaminated foil) and labeled. Prior to sealing the jar, 1 or 2 milliliters of DI water shall be placed in the jar to maintain 100% humidity in the jar during shipment. Note: If a Sharpie or similar marker will be used to label the jar, labeling of the jar shall be done only after the jar has been sealed. In the case of the deployment trip blank Sharpie use can resume only after the sampler has been re-wrapped, placed in the cooler and closed.

Polyethylene Passive Sampler Deployment

Just prior to installation, the measured sediment thickness will be used to determine how deep the Polyethylene Passive Sampler will be installed. If the probed sediment depth is deeper than the desired 66 cm sampling length of the sampler then a location with a more shallow sediment bed thickness will be found. If this is not possible, then the sampler being deployed at this location will be inserted such that a minimum of 5 cm of the exposed Polyethylene film remains in the water column. A minimum of 13 cm of sediment will be required so that beyond the bottom end of the metal frame, at least 5 cm of the Polyethylene film is submerged in the riverbed for porewater collection. Once an appropriate location has been determined and the field team is ready, one Polyethylene Passive Sampler frame shall be removed from the cooler. If an extension rod, vise-grip handle or other device is being used to aid in installing the sampler then the metal frame shall only be unwrapped enough to expose the area where the device will be attached. Similarly, the frame shall only be unwrapped to the point where the attachment hole is revealed. Once revealed, a polypropylene retrieval line shall be affixed and securely tied. A second attachment hole is also available. In the second hole a fishing bobber with line shall be attached. The bobber will be a secondary locating device. The bobber shall be left slack so that debris does not

build up around it while the sampler is deployed. Then, the sampler shall be unwrapped at the shoreline (Note: keep the foil with the location of the sampler etched into the foil) and a small binder clip shall be attached to the downstream side of the sampler at the distance of the sediment/water interface or the water/air interface to aid in the installation. Then the sampler will be carried to the sampling location and pressed into the sediments to the predetermined depth marked by the binder clip. The clip will then be removed. Measurements shall be made to document this depth. The retrieval line shall be positioned safely along the riverbed so that debris will not catch onto it. The free end shall be securely attached to a yellow or orange plastic stake and driven securely into the soils at the riverbank. Appropriate flagging tape, or paint markings, will be used to aid in finding the retrieval line at the end of the deployment period.

NOTE 1: It is important that the location where the sampler is pressed into the sediments has not been disturbed during probing, confirmatory coring, or standing on the riverbed.

NOTE 2: The orientation of the sampler, once installed, shall be such that the top edge of the sampler is parallel to the direction of river flow. This will minimize the profile of the sampler to the river flow and reduce contact with debris floating downstream.

NOTE 3: A minimum of 5 centimeters of polyethylene film needs to remain in contact with the water column above the surface of the sediment bed to provide a sufficient sample size for the surface water sample.

If during the installation it feels as if the sampler has encountered debris or other material which may have ripped the Polyethylene film, then the sampler shall be extracted and inspected. If the sampler appears intact then it shall be reinstalled at an adjacent location where the sediments have not been disturbed. If the Polyethylene film has been ripped, or otherwise severely punctured, then a replacement sampler shall be installed at an adjacent location where the sediments have not been disturbed.

Polyethylene Passive Sampler Retrieval

At the end of the designated period, approximately 30 days, or as otherwise determined by the project team, the Polyethylene Passive Samplers will be retrieved. Find the tape/paint markings to locate the general location of the sampler, locate the stake holding the retrieval line. Following the retrieval line, walk toward the Polyethylene Passive Sampler location, taking care not to step on the sampler. Feel around the deployment location and remove any debris that might contact the sampler upon removal. On the shoreline, have a decontaminated scissor and the clean 40 milliliter VOC vial ready to put the Polyethylene film into. To remove the sampler from the sediments, grab the top frame of the sampler, taking care not to touch the Polyethylene film. Pull up firmly and slowly until the sampler is completely out of the sediment. If the frame is jammed into the sediments and it appears that the Polyethylene film might be ripped from the frame, use a flat-blade gardening shovel to clear some of the sediment from near the sampler, relieving some of the pressure of the sediment on the frame. Then firmly, gently and slowly remove the sampler vertically from the sediments.

Additionally, the Passive Sampler may be “sandwiched” between thin Plexiglas sheets during retrieval to protect the Polyethylene membrane from subsurface rocks and debris. The Plexiglas sheets would be slid down along the sampler into the sediment bed on either side of the passive sampler to provide a barrier between the subsurface debris and the polyethylene membrane. The passive sampler would then be slowly and carefully removed from the sediments. The Plexiglas sheets would then be removed from the sediment once the passive sampler is retrieved. Note: Prior to using this technique the crew will assess the location to determine if damage to the membrane will be prevented or caused by doing this. Best judgment will be used.

Once the sampler is out of the sediment, but still in the water, use the river water to rinse off the sediments. It is not likely that there will be a build-up of biological growth on the Polyethylene, however if there is, or stubborn sediments are attached, remove it by gently rubbing with a Kim-Wipe dipped in river water.

Remove the frame from the river and bring to the shore. Three samples will be collected from each Polyethylene sampler. The three proposed depths are (1) the section of polyethylene sheet above the sediment-water interface that is exposed to the surface water, (2) the section of polyethylene sheet that is below the sediment-water interface (0-5 cm) that is exposed to the porewater in the biologically active zone, and (3) the bottom 5 cm of the polyethylene sheet (this exact depth will vary depending on the penetration depth of the sampler) that will be proximal to bedrock in some areas.

Use a decontaminated scissor to each section of Polyethylene film. Each section will then be cut in half lengthwise, yielding two 2.5 cm by 5 cm sections of film. Use tweezers to hold and transfer the film sections into separate 40-milliliter vials along with 1 to 2 milliliters of lab-grade DI water. Cap the vial with a foil-lined cap. Label each vial the sample ID (note: the pairs of 2.5 by 5 cm polyethylene film sections will have the same sample ID), place Ziploc bags and store in a cooler on ice. Pack as normal, complete COCs and ship to the analytical laboratory. Remaining polyethylene film should be archived for possible future analysis. Use a decontaminated scissor to cut a small notch in the top of the film. Roll the film and place into a vial with DI water as previously described.

VOC Sampler Installation

VOC Samplers shall be deployed adjacent to the Polyethylene Passive Samplers as follows:

VOC samplers will consist of three 40 ml VOC vials filled with lab grade DI water, and capped with a clean Polyethylene film. The film is affixed to the lid using a stainless steel wire or a metal septum cap. Groups of 3 vials shall be deployed simultaneously, in an inverted position. The deployment period shall be 30 days. Alternatively, commercially available PDB samplers may be used.

The VOC samplers may be deployed at different times: they may be deployed up to a week prior to Polyethylene Passive Sampler deployment, or at the same time that the Polyethylene Passive Samplers are deployed. In either case care shall be taken to avoid stepping in the area where the samplers are to be deployed.

The following sequence comprises the deployment and retrieval of the VOC samplers:

- Install the VOC sampler in a location adjacent to, but downstream of, the Polyethylene Passive Sampler.
- Use a core tube to remove sediment down to the bottom of the Polyethylene Passive Sampler level.
 - The sediment sample retrieved during this period may be used as the confirmatory or geotechnical sediment core.
 - If the sediment will not be retained for geotechnical or classification purposes, the sediment must be disposed of in a manner consistent with SOP No. 26: Management and Disposal of Investigation-Derived Waste.
- Install core tube to the bottom of this interval. The top of the tube should end approximately at the water surface.
- If using VOC vial apparatus:
 - Fill three VOC Vials with DI water and cover each with a Polyethylene Film. Tie the film on the bottle top using stainless steel wire or cover with metal cap.
 - Tie 3 VOC vials together with stainless steel wire.
 - Tie a stainless steel retrieval wire to the vials.
- If using commercial PDB:
 - Fill PDB sampler with DI water. Note: sampler may be purchased pre-filled.
 - Follow manufacturer's installation instructions for securing PDB inside of tube.
- Fill the core tube with river water.
 - Using a peristaltic pump attached to a Tygon tube, pump river water into the core tube, inside the tube near the bottom of it, until the overflowing water runs clear.
 - Pump at least 1 gallon of DI water into the tube near the bottom so that the river water has been purged from within the tube.
- Install the three vials upside-down (or PDB according to manufacturer's instructions) in the core tube with the SS retrieval wire coming out the top of the tube.
- Affix a Teflon coated weight to the retrieval line just above the VOC vials or PDB.
- Allow the end of the stainless steel wire to come out the top of the tube.
- Cap the tube with one of the core tube caps and tape it on with 3M 33+ electrical tape.
- Tie a retrieval line from the core tube to the stake securing the Polyethylene Passive Sampler.
 - Make sure the line to the core tube has been secured with 3M 33+ electrical tape.

VOC Sampler Retrieval

- At the end of the deployment interval (30 days), remove the vials or PDB from the core

- tube by pulling them out using the retrieval line.
- If using VOC vial apparatus:
 - Invert the vials (cap end now facing up).
 - Remove the Polyethylene film.
 - Preserve samples with hydrochloric acid.
 - If using PDB sampler:
 - Transfer aqueous sample from PDB to 3 40-mL HCl preserved VOC vials. Make sure to transfer quickly to minimize loss of volatile compounds into the air.
 - Fill septum cap with reagent-grade water and pour water into vial as cap is tightened. Confirm that vials are full with no air bubbles by turning vial upside down and tapping side of glass vial. (Caps should be standard VOC Vial septum caps.)
 - Label the vials.
 - Place the three VOC vials in a Ziploc bag and store on ice.

VOC Grab Samples

- VOC grab samples are to be collected at two intervals: (1) 2 weeks after deployment of VOC sampler, (2) 30 days after deployment of VOC sampler
- VOC grab samples will be collected by from groundwater contained in previously installed VOC sampler tube. Water will be transferred to the vials using a clean disposable pipette or equivalent technique.
- Fill septum cap with reagent-grade water and pour water into vial as cap is tightened. Confirm that vials are full with no air bubbles by turning vial upside down and tapping side of glass vial. (Caps should be standard VOC Vial septum caps.)
- Label the vials.
- Place the three VOC vials in a Ziploc bag and store on ice.

Installation of the Sediment and Brook Temperature Dataloggers

Temperature data will be collected from the water column within Bound Brook and from sediments adjacent to two of the Polyethylene Passive Sampler deployment locations.

- Prior to starting the collection of data from a water column or sediment Levellogger, a Barometric Logger shall be programmed to start collection of the required barometric readings. The CDE OU2 site is a good location for the Barologger. The Barologger data collection must begin prior to the collection of any of the other Levellogger data.
- Water column temperature and water depth data will be collected from two previous Levellogger locations: one at the nearest existing upstream and one at the nearest existing downstream location. The deployment and retrieval of the Levelloggers at these locations will be performed as done so previously. Data collection shall be programmed for every 15 minutes. Data collection period will be throughout the duration of the Polyethylene Passive Sampler deployment period.

- Prior to deployment in the sediment, a tether line shall be attached to the Levellogger and the Levellogger shall be setup on the computer for deployment.
- The Levellogger shall be placed in a plastic bag to prevent damage to the sensor from sediments that could clog the unit. The bag shall be secured shut.
- Sediment temperature data will be collected adjacent to one of the Polyethylene Passive Sampler deployment locations. Care will be taken to preserve the integrity of the VOC and Polyethylene Passive Sampler locations (prevent sediment disturbance at these locations).
 - Temperature at two soils depths shall be monitored: One at the depth interval of the bottom 5 cm of the Polyethylene Passive Sampler membrane, and one within the first 5 cm below the sediment surface. Temperature data shall be logged every 15 minutes. (Depth readings are not needed although they will be a part of the data being recorded).
 - To deploy each Levellogger, a hole will be dug to the proper depth and the logger sensor placed at the proper depth. The tether shall be attached to the stake holding the Polyethylene Passive sampler and the VOC sampler. Once positioned the hole shall be backfilled and compacted.
 - Sediment and water column Levelloggers shall remain in position during the Polyethylene Passive Sampler deployment period.
- Levelloggers shall be retrieved from the water column monitoring locations, from the sediment locations, and from the Barologger logger location and downloaded into the laptop computer; Data from the Barologger shall be downloaded last.

Surface Sediment Samples

- One surface sediment sample is to be collected from each passive sampler location.
- The surface sediment sample (0-5 cm depth) will be collected adjacent to the passive sampler at the time of passive sampler retrieval.
 - It is important that the location where the surface sediment sample is collected has not been disturbed during probing, confirmatory coring, installation/retrieval of passive sampler or VOC sampler, or standing on the riverbed.
- Refer to SOP No. 21: Collection and Processing of Surface Sediments for further instruction on the collection and processing of surface sediment samples.

TITLE: Stream Flow / Water Quality Survey for Potential Groundwater Discharge

I. Introduction

This Standard Operating Procedure (SOP) describes the equipment and methods to be used to identify areas of potential groundwater discharge by stream flow / water quality survey during remedial investigation activities at Operable Unit 04 (OU4) of the Cornell-Dubilier Electronics Superfund Site.

Prior to deploying the porewater passive samplers, the United States Environmental Protection Agency (USEPA) has requested that The Louis Berger Group, Inc. (Berger) refine the proposed porewater sampling locations through a two-phase stream flow / water quality survey. The objective of these surveys is to locate potential groundwater discharge points to the brook. Berger is implementing the following program to satisfy this USEPA request.

II. Equipment and Supplies

- Marsh McBirney Flo-Mate flow meters
- Horiba U-52 multiparameter water quality checker with flow-through cell
- Trimble hand-held GPS
- 100-foot or 300-foot open-reel tape measure
- Tent stakes (for anchoring tape measure)
- Electrical tape
- Appropriate PPE including hip/chest waders
- Flagging tape and/or stake flags
- Sharpie markers
- Field notebook

III. Methods

Event One – General Survey

- Survey will start upstream of Belmont Avenue Bridge [approximately river mile (RM) 7.0], where a rock outcrop in the brook has created a stream flow restriction, and will continue to the natural confluence of Cedar Brook and Bound Brook (approximately RM5.7). The survey will cover a distance of 1.3 miles or approximately 6,800 feet.
- A water column temperature/water quality profile will be completed on transects located every 100 feet along the planned stretch (6,800 feet) of Bound Brook, which will yield approximately 69 transects.
 - Note: Data should be collected under non-storm, base-flow conditions (Refer to USGS gage: USGS 01403600 Green Brook at Rock Avenue at Plainfield)

NJ). Field crew may be required to modify the number of transects and/or distance between transects as necessary to ensure that data is collected from the entire stretch prior to any significant rainfall (more than 0.01 inches in 6 hours). Field crew may also need to modify the locations due to field conditions such as fallen trees across the brook or water too deep to wade through.

- At each transect the field crew will place a flagging stake and measure the river width at the existing water level. Along each transect, at 5-foot increments, the field crew will record the water quality parameters in the brook at 2 depths (mid-depth and bottom). Water quality parameters include: temperature, pH, ORP, conductivity, DO, and salinity.
 - Refer to SOP No. 17 (Procedure for the Calibration and Operation of a Horiba U-10) and the Horiba U-52 instruction manual for further instructions on collecting data with the Horiba U-52.
 - Note: For transects where the river width is less than 10 feet the field crew will still record water quality at two increments. In locations where the water depth is shallow (around 6 inches or less), water quality parameters may only be recorded at one depth (bottom).
- Collection of the bottom water quality data will require the use of a “hood”, designed to prevent the flowing brook water from contacting the water quality probes. The hood consists of the Horiba flow cell but with the bottom cap removed and the top port of the flow cell left in the open position.
 - To collect the bottom data, the probe, with the hood attached, is placed touching the river bottom sediments. Care is used to prevent disturbing the sediments as the hood is positioned on the bottom. (Note: The hood is positioned on the probe assembly so that the hood is able to set into the sediment while allowing the probes to remain above the sediments.) While in place, if groundwater is discharging into the river at this location, the flow into the cell will displace the water in it through the open top port. Water quality parameter readings are recorded once the values have stabilized.
 - Note: It is of primary importance to have the temperature, conductivity and salinity values stabilize prior to recording them, if possible. The field crew will note any values that have not sufficiently stabilized.
- Recording of the water quality parameters will be done once the parameters have stabilized. (Note: The “hood”, described above, may be left in place while these readings are being obtained from the mid-depth location.) Guidance for stabilization is provided below:

PARAMETER	UNITS	STABILIZATION CRITERIA	REFERENCE (EPA Low Flow Guidance)
pH	Units	+/- 0.1	Puls and Barcelona, 1996; Wilde et al., 1998
Specific Conductivity	µS/cm	+/- 3%	Puls and Barcelona, 1996
ORP	mV	+/- 10 millivolts	Puls and Barcelona, 1996
Turbidity	NTU	+/- 10% (when >10 NTUs)	Puls and Barcelona, 1996; Wilde et al., 1998
Dissolved Oxygen	mg/l	+/- 0.3 mg/l	Wilde et al., 1998

- Sample location IDs for the temperature/water quality survey will be assigned according to the following examples: CDEOU4-120507-SF1A-MID; CDEOU4-120507-SF1A-BOT
 - CDEOU4 = Cornell-Dubilier Electronics Superfund Site – Operable Unit 4
 - 120507 = Collection date with the format year, month, and day (yyymmdd)
 - SF = stream flow
 - 1 = transect number (starting upstream of Belmont Avenue Bridge)
 - A = location across transect (with A being closest to the right bank facing upstream. Continue with B, C, D, etc. moving across the width of the brook.)
 - MID = measurement at water column mid-depth
 - BOT = measurement at water column bottom (on streambed)
- A stream flow survey will be completed every 200 feet for the same stretch (6,800 feet) of the Bound Brook, which will yield approximately 35 stream flow cross-sections. Velocity data obtained from each of the segments of the cross-section will be used to calculate a final flow at each cross-section.
 - See SOP No. 27 (Standard Operating Procedure for Stream Flow Measurement) for further instruction on stream flow measurement.
 - Note: Data should be collected under non-storm, base-flow conditions (Refer to USGS gage: USGS 01403600 Green Brook at Rock Avenue at Plainfield NJ). Field crew may be required to modify the number of transects and/or distance between transects as necessary to ensure that data is collected from the entire stretch prior to any significant rainfall (more than 0.01 inches in 6 hours). Field crew may also need to modify the locations due to field conditions such as fallen trees across the brook or water too deep to wade through. Additional stream flow measurements should be collected if possible from any visible inputs to the brook.
- Sample IDs for the final/calculated flow will be recorded relative to the transect/cross-section number (one flow value per transect/cross-section location). Example: CDEOU4-120507-SF1 (Note: Each cross-section will coincide with an existing transect and bear the number of that transect.)
- A hand-held GPS unit will be used to record the location of each transect. Refer to SOP No. 06 Procedure to Locate Sample Points Using a Global Positioning System (GPS) for further instruction on recording the transect locations.
 - To check the accuracy of the hand-held GPS unit, the field crew will record the field data coordinates from the hand-held GPS for the surveyed Pennoni stakes that are positioned along the river. It is recommended that at least two

Pennoni locations be done per day.

- Note: The hand-held GPS will be set-up so that each recorded data position represents the averaged value of a minimum of 40 to 60 data points, with each data point screened to represent an accuracy of 3.5 feet or closer.

Event Two – Refined Survey

- Data from Event 1 will be evaluated in the office to refine areas where a potential groundwater discharge to the brook is observed.
- Field crew will conduct a reconnaissance of areas that indicated a groundwater discharge to the brook (based on Event 1, differences in flows and/or water quality between transects and depths would indicate a potential groundwater discharge).
- A second water quality survey will be conducted to refine and locate possible direct groundwater discharge points. These points will be used to determine the locations of 10 of the passive porewater samplers to be deployed.
- Where appropriate, flagging will be placed in the field to mark proposed porewater sampling locations. (Final locations are contingent on approval from USACE and USEPA.)